THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LX. No. 1541.] LONDON, NOVEMBER 22, 1892. [44TH YEAR. PRICE 6d.

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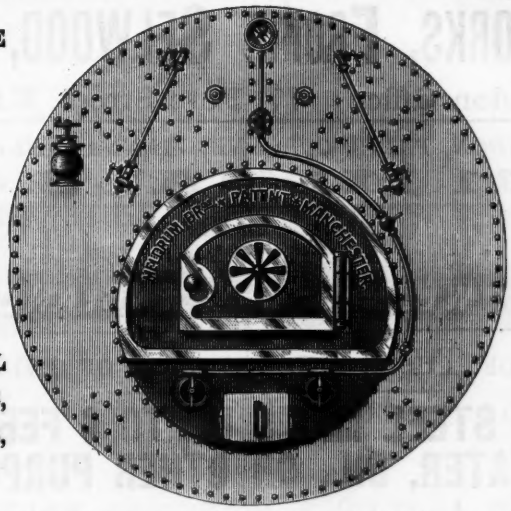

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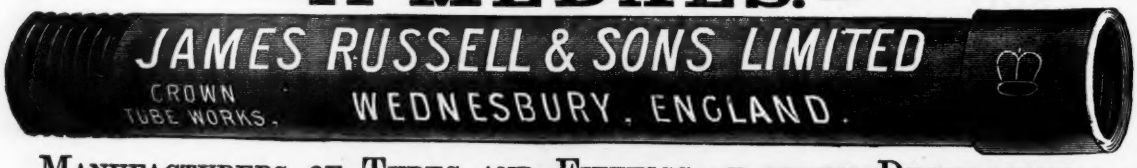

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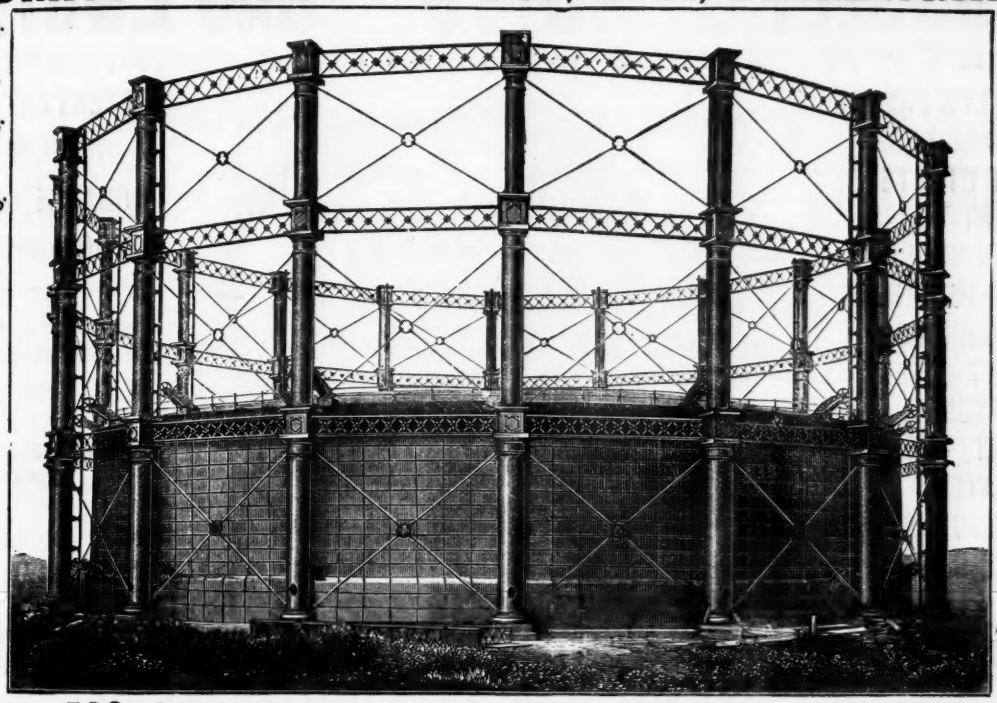

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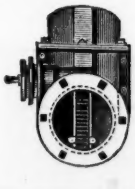

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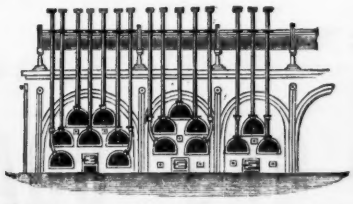

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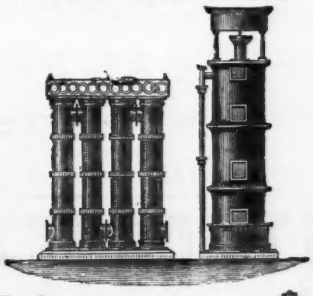

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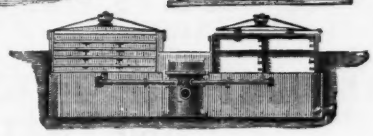

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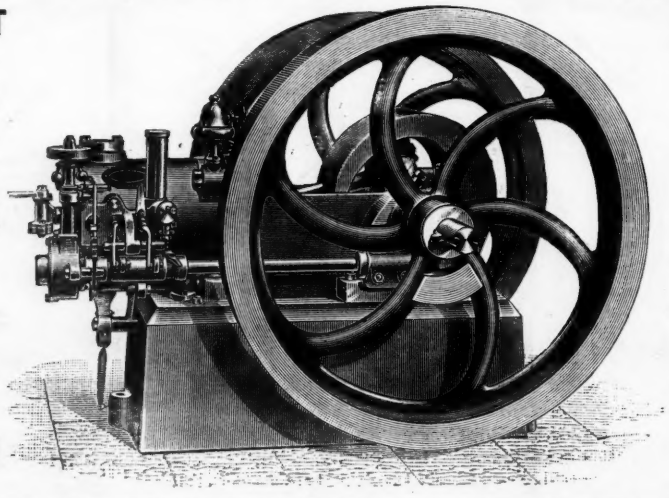

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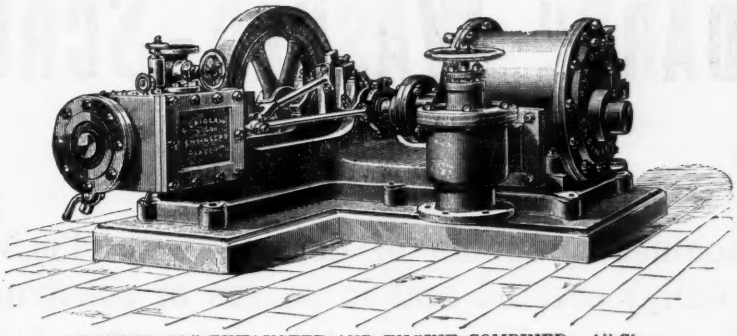

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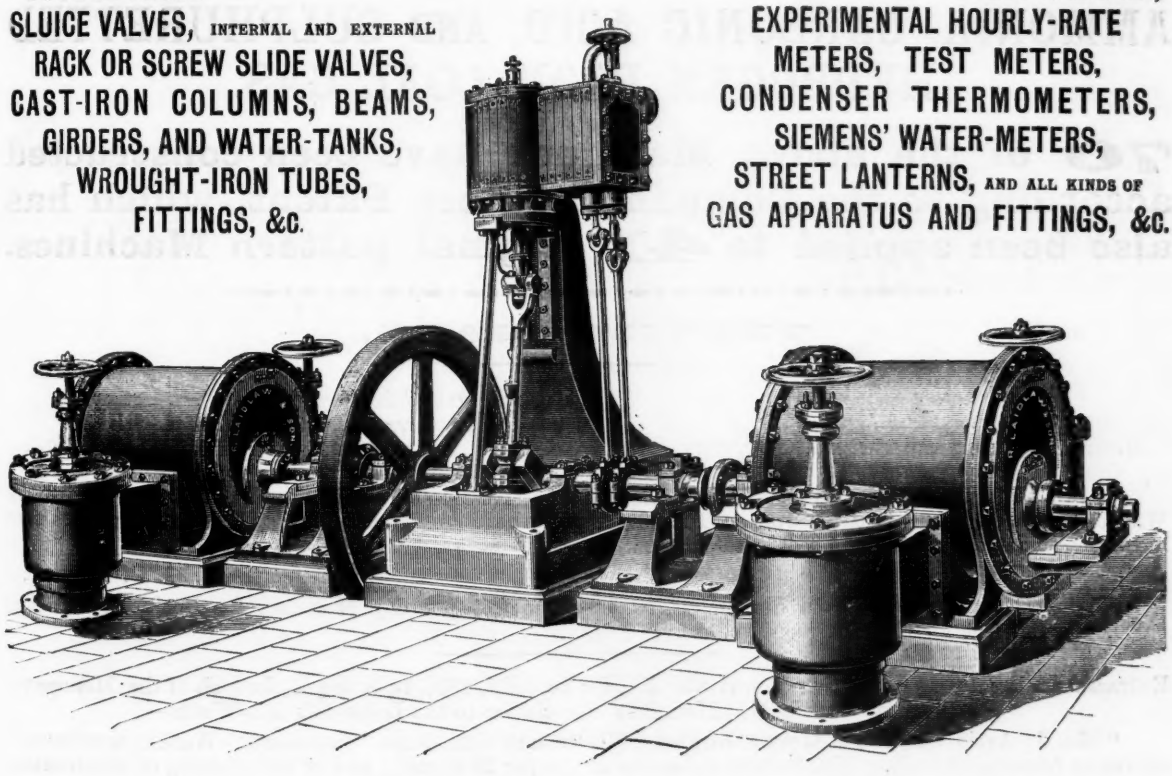

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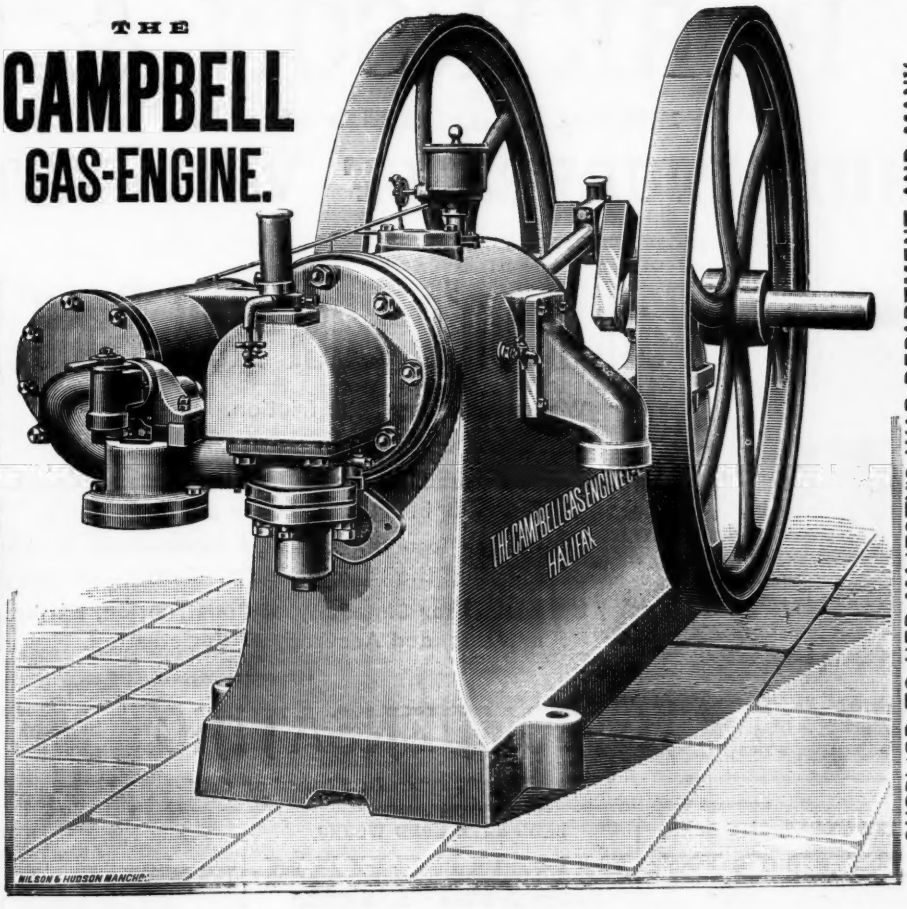

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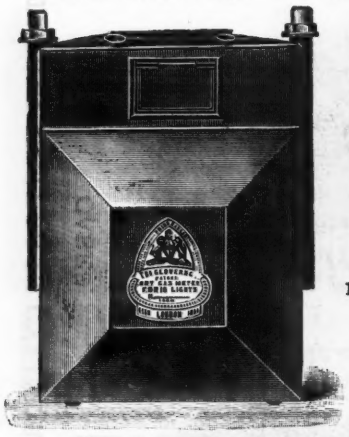

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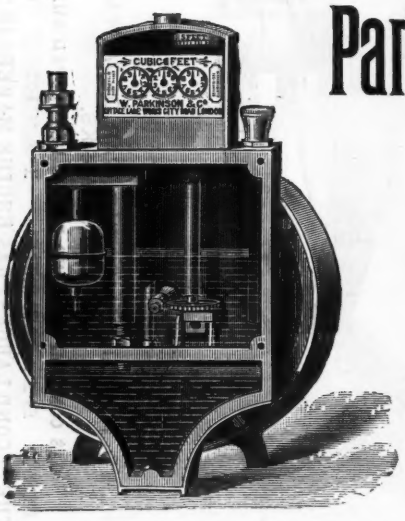

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Allows for loss of water by evaporation without materially affecting the registration or shutting off the gas.
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TO ADVERTISERS.

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, NOVEMBER 22, 1892.

The Crystal Palace District Gas Company in Parliament.

THE Crystal Palace District Gas Company have given notice of their intention to apply to Parliament, in the ensuing session, for further powers. The Bill will contain several proposals of a noteworthy character; and if these are sanctioned, the Act will form an important precedent for future legislation in regard to sliding-scale Gas Companies. In the first place, it is proposed to raise additional capital by the creation of consolidated ordinary stock bearing a standard 5 per cent. dividend, subject to an increase or decrease of 2s. 6d. per cent. per annum for a penny reduction or increase in the price of gas. All the ordinary 10 and 7 per cent. capital is to be converted into its equivalent of the new consolidated stock; and the existing debenture stock is also to be converted in the same way—the borrowing powers being extended to an amount equal to one-third part of the ordinary capital, including premiums, for the time being paid up. This proportion of loan capital is to be maintained as nearly as may be at all times; and upon the passing of the Act the necessary amount of debenture stock is to be issued to make up the prescribed proportion before any consolidated stock is created or raised. All capital is to be sold by auction or tender, with the proviso that the Company may, if they think fit, offer the same, either wholly or in part, to the consumers of gas in their own district, or to persons in their employ, at the market price of the day, or on such terms as the Board of Trade may approve. Other clauses of the Bill are to authorize the Company to amalgamate their undertaking with that of any other Gas Company within the Metropolis and on the south side of the Thames; to alter the provisions relating to the quality of the gas supplied by them; and to make arrangements with the South Metropolitan Gas Company for the landing and delivery of coals and other things at the East Greenwich coal jetty of the latter Company.

The chief interest of the proposed Bill lies, of course, in the suggested rearrangement of the capital. The precedents of Bristol and Oxford are followed and systematized, so as to leave out of account the local considerations which operated in these instances, and to lay before Parliament the clear issue of the expediency of reducing the nominal rate of interest upon the capital invested in an old-established Gas Company to a figure nearly expressing its actual return to purchasers in the open market. There is nothing exceptional in the position of the Crystal Palace District Gas Company that should induce Parliament to effect this alteration; but, on the other hand, there is no reason why the change should not be made at the request of the Company, supported by proper argument. It will be noticed that the usual proportion between the amount of the rise and fall in the rate of dividend and alterations of the selling price of gas is to be preserved. With a 10 per cent. stock, the ratio is 5s. per cent. for a penny; with a 5 per cent. stock, the ratio should therefore be 2s. 6d. per cent. for a penny, as proposed. This necessary correction gets rid of the anomaly of 7 per cent. stock taking the same rise and fall as 10 per cent. stock, which has never been justified by reference to arithmetical or other considerations.

The reasons which have prompted the Directors of the Crystal Palace District Gas Company to propose this unification of their capital obligations upon a 5 per cent. basis will be stated in due time, but they may probably be summed up in the arguments for simplicity of denomination and book-keeping in respect of the capital account, and for conformity of nominal to actual rates of dividend. The need for graduated rates of dividend only exists when difference of rate corresponds with actual difference of risk. When a trading company cannot raise capital at 5 per cent., the object may be attained by offering 6 or 7 per cent. So soon, however, as the whole of a company's capital commands a premium, the import of the nominal rates of dividend payable on various classes of the stock changes. If a gas company can sell 10 per cent. capital at a premium which reduces to 5 per cent. the return to the investor, it is open to be argued whether it is better for that company and the public that this state of things should continue, or that the company should dispense with the benefit, such as it is, of receiving so large a proportion of non-dividend bearing premium capital, and should take such steps as will bring the dividend into closer connection with the interest of the investor.

What is the benefit of premium capital? In the ordinary way, the difference to the issuer between £100 of 10 per cent. capital and £200 of 5 per cent. capital is indistinguishable. Yet it is clear that a gas company does derive some benefit from having the use of a non-dividend bearing premium capital, altogether apart from the illegitimate gain recently commented upon in these columns with reference to the receipt of full premiums upon partly-paid shares. The benefit may not be susceptible of exact expression; but it consists in the fact that the investor at a premium stands the risk of possible shrinkages in the

value of the stock over which neither he nor the company has control. The undertaking, that is to say, has always the premium capital to the good. There may not be much in this consideration; but there is something. At any rate, the point we desire to bring out is that, in voluntarily relinquishing the prospect of being able to go on piling up premium capital, a gas company does give up something of real, if indefinite value. What, then, is to be gained by stock unification or consolidation upon the lower basis? Briefly, besides simplicity, safety is the object aimed at. It seems to be a growing impression upon the mind of gas financiers, that the high nominal rates of dividend that have come down to us from a period when gas shares were speculative investments, constitute a certain source of irritation for the non-participating public. It has to be continually explained that these apparently usurious returns do not represent the facts; but while the explanations are forgotten as quickly as excuses and apologies of all kinds usually are, the cause of offence remains posted in the market-place. Moreover, the popular adage that connects high interest with bad security is thought to affect in some degree the estimation in which non-speculative investors hold gas stocks. And the high nominal value of such stock is directly responsible for the smallness of its amount, and the consequent difficulty of dealing in it. If all gas stocks were 5 per cent. investments, nominally as well as actually, there would be so much more wherewith to make and keep a market; and the quotable value of the property would be distinctly higher. Such appears to be the gist of the case advanced by those who support the line of action taken by the Directors of the Crystal Palace District Gas Company.

Upon the project for issuing gas stock to consumers and employees, and treating these classes of interested investors as privileged, in a certain way, there is something to be said. The small investor is deserving of particular consideration just now. Broadly speaking, up to the present time building societies have been the only means of profitably employing savings open to the struggling frugal among our town population. The trafficking in small lots of stocks and shares which is such a feature of the thrifty life of the French lower *bourgeoisie* has no parallel in England. But the building society has become symbolical of the aspirations of the Briton after a "stake in the soil." Circumstances, which need not be particularized here, have rendered it desirable that building societies should be supplemented by other means of investing limited amounts of savings; and why should not gas stock rank among these? The suggestion is not original; on the contrary, it has been tried elsewhere, with such good results that there is no ground for supposing that it would not succeed in the Crystal Palace district. We wish the Directors of the Company well through their parliamentary trials; being assured that, if they only have the fortune to meet with reasonably intelligent Committees, the result of their appeal for the improvement of their statutory conditions will be a general advance in the legislative control of gas supply.

Tom Mann before the Labour Commission.

The advantage of allowing everybody to state his opinions freely has often been illustrated in England, especially in the case of political firebrands of Continental origin, who have come over here time and again to exhibit how the danger of most explosive materials only exists when they are kept down by pressure. Nihilism, Communism, Internationalism, and all the other "isms" that give so much trouble to the Continental gendarmerie, fizzle out like a damp squib under the stolid gaze of the British policeman, representing the depressing indifference of a community that cares nothing for wild language unrelated to specific illicit action. As with politics, so with sociology; there is, after all, nothing like letting people talk themselves out. Of this a good example in point was supplied last week by the appearance of Mr. Tom Mann before the Labour Commission. If there were any section or class of English people inclined to take Tom Mann seriously, as a prophet of a new and workable dispensation competent to bring in the Millennium "by the head and horns," such faith in the Social Democratic mouthpiece of the New Unionism can hardly survive a critical study of the figure he made before the bland and patient Commissioners. It is one thing to orate at large about generalities for the amusement of scratch assemblies of loafers and day labourers, and something entirely different to put together a brand new theory of employment, involving the disestablishment of poverty, that will hold together under the questioning of such men as constitute the majority of the Labour Commission. To say that Tom Mann failed under this test, is only to corroborate what everybody capable of appreciating the facts of industrial civilization believed beforehand. He showed a certain adroitness in fencing for three days on end with awkward questions; but, though the full pressure of which cross-examination in skilled hands is capable in regard to exploding a made-up story was not applied to him, he left a general impression that his Socialistic remedies for the ills of the body politic depend upon assumptions which not only lack all support by facts, but actually ignore or run counter to considerations true in universal experience. Mr. Tom Mann was followed by Mr. Sidney Webb, one of the leaders of the Progressist party in the London County Council, who is a smart man in his way, which is not perhaps a very large way. It is just as well that theories respecting employment should be aired before the Commission, the members of which deserve great praise for the self-restraint they display in refraining as they do from "making points" at the expense of self-contradictory witnesses. Counsel clever at browbeating and tripping up men in their talk, may sneer at the style of examination that appears to satisfy the Commission. But it is easier to disconcert a Commission witness than to quell the social movement which he represents; and it is a saving of time to hear a man out.

Is Naphtha Explosive?

The difficulty that may occur in the logical process of descending from the general to the particular was well exemplified recently in a New York lawsuit instituted by the Board of Fire Commissioners against the Standard Gaslight Company. Certain clauses of the Act of the Legislature under which the State of New York is, in theory, governed prohibit the storeage of "explosive substances"—in the first place, without proper fixtures and arrangements to secure safety; and, secondly, without a permit from the Fire Commissioners. The Commissioners discovered that the Gas Company (which is a water-gas concern) had a quantity of naphtha stored upon the works without a permit. If one may judge from home experience of the conflicts of gas companies with public authorities of various descriptions, this question of the lack of a permit was probably a case of the non-payment of certain fees to officials who considered themselves entitled to them. However this may be, the Gas Company in the case under notice took the objection that naphtha is not an explosive within the meaning of Act. Upon this issue the parties joined, which is a remarkable thing, because it seems to show that in New York the storeage of naphtha is not specifically regulated, but that petroleum spirit is regarded as coming under the law only as an "explosive" substance. There could be no such quibble in this country, because there are Acts of Parliament specially dealing with petroleum and its derivatives by name, irrespective of the question whether they are or are not explosive. The difficulty of definition in this regard appears to be a real one in New York; and, in connection with this lawsuit, witnesses and lawyers played with words in the spirit that has done so much to bring the word "law" into derision the world over. "Is naphtha explosive?" one witness is asked. He has never entertained a doubt on the point; but he is tortured by cross-examining counsel into saying that naphtha can be made to explode if confined. So will water in a boiler. "Is water therefore an explosive?" Silence of the witness; triumph of the lawyer. Then a Professor of Chemistry is put into the box on behalf of the Gas Company; and he declares that "under "no circumstances can naphtha be called an explosive." This expert, in fact, went so far in his zeal to earn his fees, that he sought to convey the impression that gunpowder is not, strictly speaking, an explosive substance, being "harmless so long as it is not brought "into contact with fire." Ultimately, this very ingenious expert was fain to declare that the resources of the great American language are insufficient to express his truly scientific views respecting the nature of explosives and explosions. Experts ought to be allowed to frame a language of their own when the exigencies of their proofs require a demonstration that black is white. This is the

top record of *expertise*, so far as the art has yet been carried; and we are perfectly content to ascribe it to a foreign source.

Trusts, Unions, and Combinations.

THE announcement that the Standard Oil Company of America have withdrawn from the agreement which they had made with the Scotch shale oil firms for upholding the price of paraffin, comes as a reminder of the inherent weakness of trade combinations of this character. It is to be supposed that the American Company had some reason for entering into this agreement, and for abiding by it so long. But it is evident that this reason, whatever it was, has ceased to operate; and they consequently take the liberty of throwing over their old allies, regardless of all consideration of the circumstances of the latter. It would be interesting to know the whole story; but we doubt whether it will ever be told. There is something pathetic about the spectacle of the American petroleum interest throwing its mantle round the perishing Scotch paraffin industry, and thus keeping it warm for a time—only to snatch away the protection just when external conditions are most trying, and the resisting power of the suffering industry has been sapped by years of reliance upon extraneous aid. Scotchmen are too well schooled in classical lore to see anything new in the maxim: "*Timeo Danaos et "dona ferentes;*" but some of them seem to have forgotten the spirit of the saying when they placed reliance upon the faith of the Standard Oil Company. Of course, this breakdown of an international combination formed to keep up the price of paraffin will be quoted as evidence against the idea of all trade organizations aiming at a similar object. It is nothing of the kind, but only an example of the necessity for making sure that all the elements of a combination are upon equal and similar bases. If one corner of a tower stands upon clay while the others are founded upon rock, the probability is that the structure will settle unequally, and perhaps fall. But this is no argument whatever against the proper building of towers. Judgment upon the question of combinations, always assuming their objects to be legal, must be very largely affected by considerations of degree. A Trade Union is essentially a combination of workers to force up the standard of wages, which is not now an illegal object. But judgment on the proceedings of a particular Trade Union must go upon the merits of its proceedings. If the Union is really representative, is in a position to support its members in carrying out its counsels, and its demands are reasonable and prudently timed, the chances are greatly in favour of its gaining its point. Similarly, if a combination of producers is representative, and its objects reasonable, it will prevail. In both cases the result will redound to the credit of the system generally; but this is apt to cause mistakes. A correspondent of *The Times*, writing last week upon the defeat of M'Kinleyism at the recent presidential election in the States, remarks that "the average thinker on economic questions "has probably come to a decision upon two points—"first, that labour has a right to organize and a right to "strike, but not a right to use violence as an argument, or "to prevent non-union men from taking in hand work union "men have declined to perform; secondly, that capital has "a perfect right to combine when its object is to prevent "senseless reduction in values, safeguard credits, extend "trade, but has not the right to form a combination, under "cover of which production at many different factories is "arbitrarily suspended, willing workers are thrown out of "employment, industry is paralyzed, and the price to the "consuming public of the necessaries of life is greatly and "arbitrarily advanced." This is as much as to say that there is nothing essentially good or bad, right or wrong, in such arrangements as workers' unions or employers' federations, but that judgment must go in every case upon their proceedings, which may be beneficent and reasonable or the reverse.

Completion of the New Five-Lift Holder at East Greenwich.—The new five-lift holder at the East Greenwich station of the South Metropolitan Gas Company, of which the guide-framing is carried to the height of three lifts only, has been filled with air, with a thoroughly satisfactory result. It is intended this week to put gas into the holder. The builders were Messrs. Clayton, Son, and Co., Limited, of Hunslet, near Leeds; and we understand that the Directors of the South Metropolitan Company are highly pleased at the punctuality with which the contractors have fulfilled their engagement, and at the excellence of their work throughout.

WATER AND SANITARY AFFAIRS.

THE Royal Commission on the Metropolitan Water Supply held three meetings last week; the first two days and part of the third being occupied with evidence as to the quality of the water supplied by the London Companies. Dr. W. Odling and Mr. W. Crookes, F.R.S., occupied the greater part of the first day's sitting of the Commission. The former witness remarked on the fact that outbreaks of typhoid fever among the populations on the upper courses of the Thames had not been followed by any development of that disease in the Metropolis. He considered the question was really one of dilution; the quantities of sewage entering the river being relatively so minute as to be perfectly insignificant. There was also an enormous destruction of foul matter by the oxygen in the stream above the intakes of the Water Companies. The evidence given by Mr. Crookes went to show that the quantity of bacteria in food and air was such that people had no reason to fear the small proportion found in the water supply. Professor W. R. Smith, the Medical Officer of Health and Public Analyst for Woolwich, whose experience in the examination of waters was extensive, spoke of the supply from the Thames and the Lea as chemically pure. Dr. E. Ray Lankester, on the second day, said he was now conducting experiments for the purpose of tracing the history of the typhoid bacillus, so as to determine when it entered the Thames, and to discover what became of it. Bacteria, he remarked, did not go on growing for ever in the river. He was accordingly anxious to know what the end was, and when it occurred. The conclusion at which he had already arrived was that the Thames water, as supplied by the London Companies, was actually free from matter injurious to health, and was likely to continue so; the guarantees for purity becoming greater rather than otherwise. Dr. Klein came before the Commission, stating that he had made a report to the London County Council on the character of the bacteria found in London water. He had examined several samples; and in no case had he detected any evidence that pathogenic bacteria were actually present in the water, though he did not consider the results conclusive—the examination being so limited in character and time. Dr. Percy Frankland laid before the Commission comparative analyses of filtered water from the Thames, the Lea, and Loch Katrine; the organic matter being rather less in the Lea water than in the supply from other sources. On the third day, Dr. T. O. Duffield, the Medical Officer of Health for Kensington, dwelt on the mischief accruing from foul cisterns—an evil more prevalent in the better class of houses than among tenement dwellings. Domestic filters were also mentioned as being in many cases the means of polluting an otherwise good supply. Finally, some more engineering evidence was adduced; Mr. Walter Hunter, a Director of the Grand Junction Company, and Mr. Alex. Fraser, the Company's Engineer, giving particulars of a scheme which they had prepared for establishing intakes, reservoirs, and pumping-stations between Hampton and Wraysbury. The project was intended to be carried out by instalments, as the population increased. The flow at Teddington would still have a minimum of 200 million gallons per day; and it was not proposed to take in any flood water. The estimated cost for the complete works was £5,391,000. It was calculated that, by the proposed scheme, a supply of 300 million gallons per day would be obtained. Other of the London Water Companies, besides the Grand Junction, had been consulted in the matter. Mr. George F. Deacon gave evidence adverse to the proposals of the Thames Conservators for the construction of storeage reservoirs in the Upper Thames Valley. He said of the two he should prefer the scheme of the Water Companies. Mr. Alexander Binnie, Engineer to the London County Council, likewise opposed the proposals of the Conservators. With this the third day closed; and, on the whole, it may be said that last week's proceedings before the Royal Commission were in some respects the most important that have taken place. Evidence of the highest order has been given in favour of the present supply; and a scheme has been drawn out which shows the amplitude of the existing resources, if duly turned to account.

The annual report of the Local Government Board,

recently issued, contains Major-Gen. A. de Courcy Scott's report on the Metropolitan Water Supply for 1891. There is some variation in the basis of the statistics, as compared with that of 1890, owing to the numerical facts brought to light by the Census of 1891; the increase in the population of Greater London during the decennial period proving to be considerably less than was expected. The seemingly absurd result presents itself that, while an average population of 5,661,640 was reported to be supplied with water in 1890, the number for last year is given as being only 5,494,956. The effect on the estimated annual increase of population in the districts of several of the Companies is therefore very marked. Taking the range of the previous ten years, the average annual increase in the East London district drops from 31,114 to 17,250, comparing the estimated figure with the actual. The Grand Junction increase recedes by more than one-half —the estimated average being 11,743, while the actual proves to be only 5246. As the population is growing less rapidly than was expected, there is the less force in the argument which has been used, that the total supply is likely to fall below the demand. The liberality of the individual supply is also shown to be greater than was thought; the average daily quantity per head becoming 32·09 gallons last year, compared with 30·93 gallons reputed in 1890. This takes place, although the returns as to the quantity of water pumped have in several cases been corrected, so as to show a smaller amount. The actual supply in 1890 was 31·15 gallons per head. Hence it will be perceived that there has been a real advance in the supply per head on the corrected basis in the case of the entire Metropolis. In fact, 32·09 gallons per head is a higher ratio than is to be found in any previous year of the decade, with the figures duly rectified. As in his previous report, General Scott states that considerable progress has been made during the year in extending the system of constant supply. The measures taken to prevent waste are adverted to, including the use of Deacon's waste-water meters. On the subject of filtration, some practical remarks are made; all the Companies not being equally perfect in their plant. Treating of the quality of the supply, General Scott admits that the weather in 1891 was remarkably unfavourable for the operations of the Companies drawing from the Thames and the Lea; but it is stated that, as a rule, the Companies were able to clarify the water effectually before delivery. An account of new works undertaken or completed concludes the text of the report, which is accompanied by sundry tables. Dr. Frankland's report follows, which has already appeared; and Mr. Allen Stoneham deals with the finances of the Companies.

The Damage to The Gaslight and Coke Company's Mains by the Fire on the Underground Railway.—A report of the arguments and evidence in the case of *The Gaslight and Coke Company v. The Metropolitan Railway Company*, which recently came before Mr. Justice Wills, and now awaits the delivery of his judgment, is in type, but is unavoidably held over, owing to pressure on our space.

The Effect of Electric Lighting on Gas Consumption.—In conjunction with the recent remarks in our editorial columns on the Belfast Gas Question, it may be interesting to reproduce, from the last number of *Engineering*, a few figures relating to the supply of gas and the electric light on the Continent. In Berlin, where more than 114,000 electric lights are supplied from central stations, apart from numerous private installations, the increase in the consumption of gas has necessitated new works equal to 2½ million cubic feet per day. In Hamburg, while an electric light station for 20,000 lamps was being erected, a sum of £150,000 was spent on gas-works extensions. In Leipsic, the old gas-works have been extended, and the new ones doubled, simultaneously with the erection of several important electric light installations. At Elberfeld, a manufacturing town of a little more than 100,000 inhabitants, the consumption of gas is increasing, although there is a central electric light station of 7000 lamps capacity. At Darmstadt, with only 50,000 inhabitants, the gas-works being taxed to the utmost of their capacity, a central station for 4000 electric lamps was built; but the gas-works have since had to be extended. At Lubeck, there was a decline in the consumption of gas after the central electric light station for 2600 lamps had begun operations. This, however, did not continue for more than a year; and since then the consumption of gas has been steadily increasing. In Gothenburg, the electric light has been adopted to an unusual extent, and is constantly increasing; but the consumption of gas becomes larger every year, and new gas-works have been built.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 918.)

THE past week has not developed any remarkable phase in the course of transactions in the Stock Markets. The settlement was satisfactorily adjusted, and that was the chief event of the period. Outside of that, fresh business was quiet; but prices have held their own very steadily. The only market to show much animation was the South American, where the fear should be that prices are being run up too quickly, as we pointed out some time ago. Trade is improving no doubt; but the big fall in exchange looks rather suspicious. The position of the Money Market remains the same—that is, that it may change at any moment; and the only thing that will surprise nobody is the advent of a surprise. As for the Gas Market, that is as quiet as the rest, and even quieter. Transactions were very restricted all the week. There are no changes in the quotations at all, except those arising from *ex div.* adjustment; and they are all favourable where they show any variation at all. Calculating the probabilities, stocks in general look as if they were going to have a rise. In Gaslight issues, the "A" furnished a little business pretty well every day, finishing off on the closing day with the best price of the week—220½. There was less demand for the secured issues; but what bargains were marked, were done at very good figures. None of the South Metropolitan issues were dealt in, except the "B;" and that commanded high prices. There were a few transactions in Commercial new on Wednesday, and that was all that was done in this undertaking. The Suburban and Provincial Gas Companies were so neglected that a solitary deal in Brentford new alone saved them from complete stagnation. Taking the entire range of the Foreign Companies, there is hardly anything to be noted of them. The Continentals were quiet and steady, without any change; of the Indians, Bombay figured higher, being quoted *ex div.* at the old price; while the general advance in River Plate matters served to put Buenos Ayres and Monte Video on rather better terms. The Water Companies were unusually brisk in the earlier portion of the week, though they tailed off, rather towards the end. They were all strong, and most of them improved from 1 to 3 per cent.

The daily operations were: Gas stocks in general opened very firm on Monday, but remained extremely quiet all day, without any change. Water was more active, especially Lambeth issues of all kinds. The Gas Market underwent no change on Tuesday; being, if anything, a shade quieter. Water also was less active. Wednesday's operations were of a very restricted character, and nothing moved. Thursday's business in Gas was rather more interesting; and prices generally were better. In Water, East London and Southwark ordinary rose 1½ each; and Chelsea and Grand Junction, 1 each. On Friday business in Gas relapsed again into very meagre proportions; and the only move was an advance of ½ in Buenos Ayres. Kent Water rose 3. Saturday's business in Gas was small; but prices were excellent. A further advance in Water was effected by a rise of 1 in Lambeth 10 per cents, and in ditto debenture.

ELECTRIC LIGHTING MEMORANDA.

The Cost of Private Electric Lighting—Electricity Meters and Gas Meters—The Electric Lighting of Brighton.

BEFORE commenting upon the letter of Mr. Arthur B. Gill respecting the electric lighting of the Safe Deposit Company's premises, which appeared in our last issue, we desire to take this opportunity of assuring electricians, and all who may be interested in the matters that are treated editorially in the JOURNAL, of our perfect readiness at all times to give correspondents every reasonable facility for bringing their own views before our readers. We have, of course, decided opinions of our own; and we never seek to hide the leading motive of making the best showing for gas that is consistent with regard for truth. This seems to puzzle some of our critics occasionally; but we are glad to hear from anybody who can add to the general stock of information relating to the subjects that ordinarily occupy our columns. Mr. Gill is a welcome correspondent, both on account of his having something to say, and also for his way of saying it. We were clearly mistaken in our impression that the electric lighting of the Safe Deposit Company's premises involved the use of a gas-engine; but it is almost as satisfactory to know that it is done by coke. Mr. Gill does not make it clear how much the Company save by their electric lighting. But they are evidently satisfied that they do save; and this is everything. As to the setting off of the cost of driving the dynamos against that of ventilating, we should like to be assured that this is not attended by any sacrifice of what is necessary to health and comfort. Our own experience of electrically lighted interiors is that they need as much ventilation as if gas were burnt; at any rate, if they are occupied by many people. It may possibly be otherwise with unoccupied vaults. For the rest, Mr. Gill's letter abundantly discloses the weak spot of central station lighting schemes. Why, in the name of all that

is reasonable, if a householder with a fancy for electric lighting can serve himself for 1½d. per unit, should he pay a company four or five times as much for a probably inferior supply?

A correspondent of the *Electrical Review* is very indignant because the Editor of that outspoken print has declared that no electricity-meter has yet appeared which can compare with a gas-meter in simplicity, reliability, cheapness, and perfect fitness for its work; and he remarks that "this statement must be challenged in its entirety." By way of doing so, however, the writer goes on to observe that "the simplicity of the gas-meter may be admitted freely, as well as its accompanying cheapness." This is a queer way of challenging a proposition "in its entirety;" but let it pass. What the correspondent means is that gas-meters are not always perfectly reliable and fit for work; for he tells a harrowing tale of a meter that was more than 30 per cent. fast. This experience naturally soured the gentleman against gas-meters; and he seems to have taken amiss the meter inspector's well-meant attempts to soothe him by confiding to him the open secret that his was not the only defective meter in the world. He is not prepared to argue that gas-meters 30 per cent. wrong are common objects of the cellar and the back hall; but he asks whether a meter that can possibly go so far astray is to be regarded as a reliable instrument. It may appear a daring proposition; but we do not shrink from avowing our confidence in the average gas-meter, albeit some of the species are sometimes found to be bad bargains. The statement of the *Electrical Review* is correct in the main—that there is nothing in the productions of the electrical instrument maker that can be said to compare favourably with a gas-meter. It is useless to fret over the fact, because it remains true after all that can be said in explanation. Gas-meters are sometimes troublesome and defective; but when the output of a gas-works is compared with the registration of the totality of the consumers' meters, it becomes apparent that the latter cannot be very far wrong.

The Hammond Company, who have been struggling to make an electric lighting business at Brighton since the year 1881, feel very much aggrieved by the action of the Corporation in starting an electric lighting station of their own without taking the preliminary step of buying them out. The Brighton Corporation, with the sanction of the Board of Trade, have ignored the claim of the Brighton and Hove Electric Light Company to have established a position in the town analogous to that of a gas company. Mr. R. Hammond has stated this claim in a letter to a contemporary, which professes to tell the whole story of how his Company has been treated by the Corporation. But, unfortunately, he has not preserved due consistency in presenting his case, as the letter begins by complaining that the Corporation refused to treat with the Company on any terms whatever for the acquisition of their undertaking; and, later, it contends that, since the opening of the Corporation venture, the Company have held their ground—"beating the Corporation at every point," and doubling their business during the past twelve months. If the latter assertion is true, it is clear that the Corporation have not done the Company any harm, but rather good; and Mr. Hammond should be thankful that his business has not been extinguished. It may, however, be doubted whether the Company's circumstances are quite so flourishing as this bare statement respecting an alleged increase of business would imply; for, in the concluding paragraph of his letter, Mr. Hammond says something about the Company having been "weakened by the heavy expense of supplying light through its experimental changes." This admission lets daylight into the whole affair. The Company would doubtless like to be recouped by the Corporation—that is, by the ratepayers—for their pioneering expenditure; but this is the very thing that the Electric Lighting Act was passed to prevent. Moreover, the principle that limited competition in electric supply might, under certain conditions, be desirable in the public interest, is recognized and acted upon by the Board of Trade; so that is does not appear that the Brighton and Hove Electric Light Company have any solid ground for the position they attempt to take up as against the Corporation.

Water-Gas Plant at the Copenhagen Gas-Works.—The Lowe water-gas plant which is now being constructed at the western gas-works in the City of Copenhagen is nearing completion, and will be put into operation early next month. The apparatus is located at one end of a disused retort-house, which has been cleared out for the purpose, and is designed in two independent sections, each of 300,000 cubic feet capacity daily, with provision for convenient extension. The city is just now obtaining samples of a number of different oils and distillates from the Russian and American fields, thorough comparative tests of which will be made under the supervision of the builders of the apparatus (Messrs. Humphreys and Glasgow, of 9, Victoria Street, S.W.), before any large oil contract is entered into. By this means the management hope to obtain a product, perhaps composed of several distillates now fractionated, that will prove cheaper and more efficient than the oils at present used in London. While the manufacture of water gas has been contemplated in Copenhagen for several years, the construction of the plant under erection is the immediate outcome of a visit of the Manager (Mr. F. D. Marshall) to America last spring.

ON BEING ORIGINAL, AND ON ORIGINALITY IN GAS MANUFACTURE.

It is a remarkable peculiarity of the human mind to be always striving after originality in oneself, and looking for it in others. We can neither rest contented in uniformity nor satisfied with any attainments. As it was in ancient Greece, so now, the chief desire of the leisured, but intelligent and inquiring, mind is "to tell or to hear of some new thing." But where can originality be found? In an age when, as a recent writer has well said, "we are associated into nothingness and criticized to death," it would seem no light matter to essay to be original. After all the intelligence that has been brought to bear upon the problems of our daily life—when, by countless endeavours, the acquirements of knowledge have been so fully classified and formulized—is there anything of importance yet left to discover, any road to take that is not well trodden? Is it still possible to be original? Undoubtedly it is; to think otherwise would be to entirely misunderstand the true meaning of originality.

What, then, is it to be original? It is to stamp all that we do with the hall-mark of our own genius. It is to evolve order out of chaos; to combine shapeless and detached masses, of matter or of thought, into symmetrical form; to crystallize into organic unity the disjointed and aimless efforts of the many; to set old truths in new lights; to breathe fresh life into the slumbering records, and to find further uses for the unregarded legacies, of the past. It is, in short, to create what was not before. This does not mean to produce a something out of nothingness. That were indeed a task beyond human powers. Even a Shakspeare cannot do that. But what he can do, and does, is to choose from out the legends and stories of the past, and from the human lives around him, the materials which, transformed in the crucible of his mind, issue in crystallized gems of literature to adorn the English language for all time. Likewise a Carlyle gets diligently together his stock of information and fact; plods patiently through heaps of musty records of the trivial details of the past; reads "hundredweights of dreary books, dull as stupidity itself"—reads, digests, and assimilates them, and by the magic of his brain evolves therefrom a "French Revolution," a "Cromwell," a "Frederick," sparkling with gems of thought, and throwing floods of new light upon their several subjects. Or, to take an example nearer home, there had been many efforts to recover the sulphur from the vat waste of alkali works before Chance produced his beautifully complete and perfect process. For fifty years had chemists been working at the problem—without success; but not without elucidating much valuable information. This does not detract from, much less destroy, the originality of Chance, who, taking up the subject with the information gained by previous workers, and bringing to bear upon the study of their failures and successes a far-reaching knowledge of chemical science, coupled with intense application, knit the disjointed fragments together into one homogeneous and perfect whole.

It is not, however, necessary to be a Shakespeare, a Carlyle, or a Chance in order to be original. But we learn from them how we may take from others, and, while making what we abstract our own, infuse into it new life and meaning, and raise its value immeasurably in the process. For the whole accumulation of the past belongs to the present; or, as Emerson has put it, "Thought is the property of him who can entertain it, and of him who can adequately place it," and thus "all originality is relative." Therefore, for a man to be original is to use everything useful that he finds to his hand and can adapt; but to use it in his own way—converting it into, or producing therefrom, something as superior to the crude thoughts or materials he works with as is his mind to the bodily members which carry out its behests.

And so we come to our special subject: How is it possible, in this age of stereotyped rule, of general highly-developed acquirements and widespread knowledge, to be original? How may a man's professional career, his daily work, show forth originality? He may bring to bear upon the problems which are presented to him a knowledge of the facts which have been before obtained. He may study these facts in the light of his own experience, and still further illumined by side lights obtained from other branches of knowledge or inquiry. He may determine to grapple with doubt and difficulty until the truth shine clear. He may resolve to accept nothing on hearsay which it is reasonably possible for him to put to the test. He may, in a word, "prove all things," holding fast to that which he finds to be good. Judged by this standard, Reuben Phillips was original when he superseded the old-fashioned wet lime purification, with its accompanying "blue billy" nuisance, by the so-called *dry* lime method. Original because, as we learn from his specification, he had not only formed a clear conception of the drawbacks of the old process, but also appreciated its good points, and then by thought and application determined how, while escaping the former, to obtain as much as might be of the latter combined with other desirable advantages. Wright was original when he discerned the one weak point remaining in the wet meter, after the successive labours thereon of Clegg, Malam, and Crossley, and by a comparatively

simple modification produced a practically perfect measuring instrument. And while the merit of originality in a high degree is due to Siemens for first putting into practical shape the idea long held, that great benefit was to be derived from returning a portion of the waste heat of a gas-flame to heighten still further the temperature of combustion, it may not be altogether denied to those who, proceeding along the road thus opened out for them, and guided now by examples innumerable both of failure and success, have of late years produced, or are still producing, simpler and equally or more efficient apparatus.

Not to awaken invidious comparisons, we have purposely refrained from mentioning living instances of original minds who adorn the profession of gas engineering and cognate branches of activity; otherwise we might have illustrated our remarks, with perhaps more point and effectiveness, by referring to now shining examples of originality in connection with gas administration, engineering, technical chemistry, and the development of the utilization of coal gas. Suffice it to say that it is a cheering sign of healthy present activity, and a hopeful one for future progress in the science (or knowledge) and art (or practice) of gas manufacture and gas lighting that, amid so much of rigid adherence to precedent and subscribing to use and wont, a leaven of originality is working, in that here and there old problems are being attacked by new ways, and the new-born difficulties of the present approached in an inquiring and original spirit.

It is surely a sign of progress that there never was a time in the history of gas lighting when activity was being displayed in so many different directions at once as at the present. Inclined retorts, regenerative firing and stoking machinery; ammonia purification, oxygen purification, and air purification; improvements in meters, burners, gas-engines and and stoves; experiments with water gas, oil gas, and carburetted gas; and researches into the constitution of, and interactions occurring in, gas-flames—all these imply that a restless and inquiring spirit is abroad, not disposed to sit down calmly, as though perfection were already attained. Nor must we omit to note, among the more interesting of the manifestations of present-day activity, the new departure that has been inaugurated in the treatment of labour questions, and in the mode of selling gas. All these are mentioned here with the view of pointing the moral that it is not so much in the thing done or attempted that originality lies, as in the way in which it is accomplished or attacked. Thus the inclined retort was among the first forms of the apparatus tried by Murdoch in his early attempts at gas making, and subsequently discarded by him for the horizontal; but we think it will, on reflection, be conceded that there is more real originality displayed in returning to that form, after having, by intelligent inquiry and experiment, determined its best shape and necessary angle, than there was in the thought which prompted its first employment. Again, water gas, oil gas, and carburetted gas are all, in themselves, old and—it might, only a short time ago, almost have been said—threadbare subjects; yet the treatment and application they are receiving, at the hands of some of the most advanced of present-day gas engineers are eminently original and practical. From this may be learned, if indeed the truth has not been grasped from what has gone before, that it is not necessary to be new to be original, neither does novelty as a matter of course imply originality. For instance, schemes have been projected for modifying, in diverse directions, the common carbonizing process. In the one case it was to produce a fuel gas in addition to the ordinary lighting gas; in the other it was proposed to curtail the distillation—leaving in the retort a semi-carbonized coke, which was to be sold as a superior fuel for ordinary fire-grates. Very novel suggestions; but until it is shown that, by a course of due reasoning and experiment, they have been properly worked out, or at least *thought* out—their advantages not over-estimated, their difficulties foreseen and provided against—such schemes are more correctly designated novel than original.

There is consolation and encouragement in all this. Consolation, in that the scope for the display of originality in connection with gas manufacture is not narrowed but widened with the advance towards perfection of the art, although the opportunities for entirely new departures may be fewer. Encouragement to devote to the solution of the problems presented by our daily work, and the furtherance of the art in which we are engaged, the highest powers of a trained intelligence, which, not accepting as final the generally received conclusions of the present, and neither deterred by new difficulties nor slighting the apparently insignificant results of the past, will examine all in the light of a wide-embracing knowledge, and with the desire to arrive at helpful truth.

Death of Mr. E. Shaul, of Penrith.—We regret to record the death, on the 9th inst., of Mr. E. Shaul, Manager of the Penrith Local Board Gas-Works. Deceased went to Penrith from Norwich; and he had had the supervision of the gas-works for many years. He was present on the occasion of the recent inauguration of the new gasholder; but he was then, and had for a long time been, suffering from an affection for which an operation was found to be necessary. This was performed in the Carlisle Infirmary; but deceased never recovered from it. He was 72 years of age, and had a large circle of friends.

DR. HOPKINSON'S NEW RENTAL SYSTEM.

One of the most instructive statements yet published relating to the cost of electric lighting under various conditions, and in comparison with gas, is to be found in the presidential address recently delivered by Dr. John Hopkinson, F.R.S., to the members of the Junior Engineering Society. All the leading technical journals have taken particular notice of this address; and it is incumbent upon us not to neglect it. The authority of the speaker is unquestioned; and, in the true spirit of the man of science, he gave his young audience of his best, just as though they had been the most critical assembly in the world. Indeed, the subject upon which Dr. Hopkinson elected to dilate with all the resources of his high intelligence and exceptional acquirements is one that might well occupy the attention of the most experienced technicians; being no other than the relationship between production and output in the electric lighting industry, with its commercial outcome—illuminated, moreover, by the example of gas. He commenced by remarking that electrical engineers now realize that they have to provide the same plant, and no more, to furnish a steady supply day and night, as to give a supply for one hour out of the twenty-four. It must be ready at any moment; and coal must be burnt and wages paid upon the scale required by the maximum output, for however short a time this is actually taken. "A supply of electricity must be delivered at the very moment when the consumer chooses to use it, and as long as, and no longer than, he pleases to use it. It cannot be very readily or very cheaply stored; and much of the cost of production is the fixed charge for plant and conductors. Furthermore, the Provisional Orders require that the supply shall be available at all hours; hence coal must be consumed, and workmen must attend, though but few consumers are drawing a supply." This is the governing consideration in central station electric supply undertakings; and it is a striking commentary upon the supposed progress of electric lighting, regarded as an industry, that the importance of this consideration remains as patent as it was in 1883, when Dr. Hopkinson essayed to secure in certain Provisional Orders some approach to proportionality of charge to cost of supply.

In order to "fix the idea," as the French say, of the importance of what Mr. Crompton has called the "load factor," Dr. Hopkinson takes two hypothetical cases, each representing an extreme. He imagines an electric lighting station capable of supplying current to 40,000 16-candle lamps at one time, with all necessary distributing plant and reserve machinery; and he computes the expense for running such a station—firstly, on the hypothesis that it is always to be ready to supply the 40,000 lamps at half-an-hour's notice, night or day, but the lights are hardly ever required; secondly, on the hypothesis that the 40,000 lights are steadily and continuously in use day and night. In the former case, the load factor is *nil;* in the latter, it is 100 per cent. If the charge to consumers is by meter at 8d. per unit, the revenue in the former case will be *nil;* in the latter, it will be £730,000 a year. These are the possible extremes; and although neither of the cases will be realized in practice, their instructiveness consists in the fact that any actual example must lie somewhere between them.

Dr. Hopkinson then proceeds to discuss the capital required for his hypothetical station. To provide for 40,000 lamps, there would be needed a delivery of 2500 units per hour, which could be done for a capital outlay of £145,000, made up as follows: Land, £25,000; buildings, £15,000; boilers and pipes, £14,000; engines, £24,000; dynamos, £15,000; switchboard and instruments, £2000; feeders and mains, £50,000. Next comes the question of running costs, some of which (such as interest) will (like the prime cost) be the same whether the plant is fully loaded or running light; while repairs will be heavier in the former case. All these annual charges for land, buildings, rates, boilers, engines, &c., are taken at £18,750 for fully loaded, and £16,410 for the other condition of working. To these expenses have to be added those for coal, stores, and wages, which, according to a calculation that need not be detailed here, make up the total annual running cost to £28,010 for lightly, and £59,250 for fully loaded plant. "Thus the cost of merely being ready to supply 2500 units per hour at any moment throughout the year will be £28,010, and the cost of actually supplying 2500 units per hour for every minute in the year will be £59,250. The undertaker, therefore, who incurs the liability to supply, ought to receive £11 per annum per unit per hour from those on whose behalf he incurs the liability; and if he receives the £11, he need not charge more then ¼d. per unit for what he actually supplies, to cover his liability."

Thus it will be seen that Dr. Hopkinson lays special stress upon the cost of *readiness to supply*, as constituting the main expense for a statutory electric lighting undertaking. No doubt, if a local authority could rate all the possible users of a public electricity supply upon this principle, justifying the rate as being for an object of general utility, they could charge very little for the current actually taken. It is a novel idea, and one that the Bradford Corporation would doubtless like to try if it had the power. Dr. Hopkinson, moreover, goes on to expound his notion that electricity compulsorily kept in readiness for supply should be charged for with reference to what it costs, taking this consideration into account, and not merely with regard to what it may be supposed to be worth. The whole thing appears to him

to be such an artificial affair, that artful means are desirable in order to place it in a condition of financial equilibrium. He says candidly: "It is clearly to the advantage of the undertaker to secure all those customers whom it pays best to supply, and, as far as may be, to compel those who are unremunerative to adopt these other methods"—of gas or oil lighting. The gas manufacturer and the oil merchant are to have the dregs of the lighting trade. Dr. Hopkinson's ideal method of charging for electricity is "a fixed charge per quarter proportioned to the greatest rate of supply a customer will ever take, and a charge by meter for the actual consumption." This plan would doubtless be admirable from the suppliers' point of view. The fixed charge need not be the same in all cases; but it is declared that "there is no object in reducing the cost of electricity for lighting in the case of any consumer much below the cost of equivalent lighting by gas, unless there are competitors in the field willing to do it"—a condition that is most nearly fulfilled, it may be stated, where large consumers have the option of generating their own electricity by means of a gas-engine. The desirable tinge of actuality is imparted to these views of Dr. Hopkinson by his statement that, in certain recent cases in which he is acting as Engineer, the Board of Trade have acceded to his recommendation of, "for each unit per hour in the maximum power demanded, a charge not exceeding £3 per quarter, and in addition, for each unit supplied, a charge not exceeding 2d." In this way the consumers who have the power of turning on the light, and do not make much use of it, would pay more than those who employ it continuously. Dr. Hopkinson admits that it would be fair to give people who might not care for this method of charging, the option of paying the maximum simple rate provided by the Order. "What is wanted is not so much an increased charge for those consumers whose lights are used for a short time, as such a special reduced charge for those whose lights are used long as will induce them to use the supply."

This "compound charge," as Dr. Hopkinson terms it, effectuates a fresh comparison between the cost of electricity and gas. Dr. Hopkinson declares that the "flat-flame burner must be large, and of first rate quality, to give more than two candles per cubic foot of gas per hour. The large majority of burners give much less than this even at their best; and, as a rule, the pressure of the gas is not regulated, and much gas is wasted as far as the production of light is concerned. Incandescent lamps give about one-quarter of a candle per watt; hence a Board of Trade unit is equivalent to 125 cubic feet of gas." Before going any further, it will be desirable to say something, from the gas engineer's point of view, respecting this statement of the comparative efficiency of gas-burners and incandescent electric lamps. Here we have the old story of the best, or, at any rate, a very good performance of the electric lamps being put, as a matter of course, against the poorest known method of burning gas. Is this fair or reasonable? Dr. Hopkinson may argue that flat-flame gas-burners are the majority—a statement which we should not think of denying, if asked to survey the whole field of a gas company's business. But even so, flat-flame gas-burners as sold now are very much more efficient than the old-fashioned iron batswings and fishtails which Dr. Hopkinson evidently has in his eye; and the use of governed burners, with wide-bottomed globes, is very much more general, even in the living and bed rooms of people of the lower middle class, than electricians seem to realize. And when we come to consider the manner in which gas is used by shopkeepers in a large way of business, and in banks and commercial establishments of a high class—the kind of house, in short, where the electric light might be appreciated for its intrinsic qualities—is it safe to assume that such householders know nothing about Argand, recuperative, incandescent, or albo-carbon gas-burners?

Dr. Hopkinson makes out, upon the assumption already noted, and apparently ignoring the cost of renewing the electric lamps, that, at the rates recently sanctioned by the Board of Trade, the comparative cost of electric and gas lighting will be as follows:—

Hours of Use per Annum.	Load Factor.	Price of Gas at which Cost of Lighting by Electricity and 16-Candle Gas are Equal
480	5·5	5s. 4d
960	10·9	3 4
1440	16·4	2 8
1920	21·9	2 4
2880	32·9	2 0
3840	43·8	1 10
7680	87·6	1 7

These figures relate to the supply of electricity without the aid of accumulators. With regard to the storeage of electricity by these appliances, Dr. Hopkinson shows that it compares very unfavourably with the storeage of gas in holders. He says: "A gasholder is at present being put up in Manchester to hold 7 million cubic feet of gas, and is to cost, complete with its tank, £60,000. With 16-candle gas, 7 million cubic feet are equivalent to 56,000 Board of Trade units. Accumulators capable of storing a 10-hours' supply cost about £50 per unit. The equivalent accumulator will, therefore, cost about £280,000. But this is not all. The gasholder is comparatively permanent; the accumulators require frequent renewals and repairs. The gasholder gives back all the energy put into it; the accumulators waste at least 20 per cent. The gasholder may be emptied as fast as you please; the accumulators, not faster than a certain rate, without diminishing their capacity. . . . If electric power could be stored as cheaply as gas, there would soon be little hope that the Gas Companies would maintain their dividends." This last is a somewhat ungracious remark, seeing that the maintenance of dividends is not the only thing to be regarded in comparing one lighting system with another.

It may be gathered, from what has been said, that Dr. Hopkinson does not greatly fancy accumulators as an addition to a central electric lighting station. He sums up this part of his case by stating that "the cost of being ready to supply and to continue to supply is about the same, whether accumulators are used or not; the additional cost of actually supplying current is about 40 per cent. more where accumulators are used than where they are not used." The main interest of this address culminates in the suggestion for a new basis of charge, taking account of the consideration that the undertaker should be paid for being ready to supply. "They also serve who only stand and wait;" and Dr. Hopkinson thinks they should have their wages. It is not a question of the system or of the estimate. "Let each one take any figures he pleases, within reason; let him assume that the supply of electricity is made by any system he wishes; he will arrive at a result broadly similar to mine. To be ready to supply a customer with electricity at any moment he wants it, it will cost those giving the supply not much less than £11 per annum for every kilowatt—that is, for every unit per hour—which the customer can take, if he desires; and afterwards to actually give the supply will not cost very much more than ½d. per unit." This is Dr. Hopkinson's point, which he labours over, because it is to him "essential to the commercial success of electric supply." He admits that "it is hopeless for electricity to compete with gas in this country all along the line, if price is the only consideration;" but he comforts himself with the reflection that, "with selected customers, electricity is cheaper than gas." Is it not a fact, however, that the chief danger with these selected customers is lest they should set up independent electric lighting plants of their own, and so snap their fingers at the central station undertakings?

Lastly, although gas engineers may at the first glance regard this idea of Dr. Hopkinson's, of charging for being ready to supply, as rather fantastic, they must not allow themselves to ridicule it, because, as a matter of fact, the same principle lies concealed in the British system of regulated monopoly in gas supply. Part of the cost of gas goes for being ready to supply the maximum demand when it arises, although the consideration is not expressed in terms, and it is not necessary to make so much of it as Dr. Hopkinson does. It is obvious, however, that, where there is a preponderating mill consumption, the manager of the gas-works would be glad to get a rental guarantee to compensate him for the irregular demands upon his plant.

Manchester District Institution of Gas Engineers.—The ninety-second quarterly meeting of this Institution will be held at the Grand Hotel, Manchester, next Saturday, under the presidency of Mr. C. Armitage, F.C.S., Assoc.M.Inst.C.E., of Lancaster. According to the programme issued by the Honorary Secretary (Mr. S. S. Mellor, of Northwich), two new members—Mr. S. Glover, of St. Helens, and Mr. R. G. Shadbolt, of North Bierley—are to be proposed for election; and the President for the ensuing year will be chosen. Two papers—one on "The Use of Oxygen in the Purification of Coal Gas," by Mr. Harrison Veevers, of Dukinfield, and the other being "An Account of a Recent Explosion in a Tar-Well," by Mr. W. R. Chester, of Nottingham—are set down for reading and discussion. At the close of the business, the members will, as usual, take tea together.

The Production of Nitrate of Ammonia.—The manufacture of nitrate of ammonia in liquor works is of comparatively recent origin; but, in consequence of the extensive demand for the salt by makers of modern explosives, it has already assumed substantial proportions. In a paper which Mr. Watson Smith read before the London Section of the Society of Chemical Industry on the 7th inst., on "A New Method for the Preparation of Nitrous Oxide," some interesting details on the behaviour on heating of ammonium nitrate were given. The author found that it melts at 153° C., gives signs of incipient decomposition at 170° to 180° C., and evolves nitrous oxide slowly at 205° C., and freely at 215° C. The evolution continues when the temperature is dropped to 180° C., while if raised to 240° C. an exothermic effect is indicated by a rapid rise of the thermometer. The salt had previously been stated to be explosive at 300° C. The production of nitrous oxide on heating mixtures of certain salts, such as one of sodium nitrate and ammonium sulphate, was considered, and the probability of an intermediate formation of ammonium nitrate denied. In the case quoted, both the salts melt above 300° C., though the mixture softens below 200° C., and gas is evolved freely at 250° C. Since this temperature is above that of the decomposition of ammonium nitrate, Mr. Watson Smith argued that this salt could not be formed from the mixture, and subsequently be broken up, but that the nitrous oxide must be given off from the mixed salts without such intermediate formation. In the discussion which followed, doubt was thrown on the validity of this argument; one speaker even stating that he had obtained crystals of ammonium nitrate by a kindred reaction.

THE PARLIAMENTARY AND LEGAL POSITION OF THE LONDON WATER COMPANIES.*

We hardly know in what light to look upon the production that is now before us. It has the appearance of a book, with a particular title, and having Mr. Henry Lawrence Cripps as its author. But Mr. Cripps is described as a Parliamentary Agent; and it is not customary for anyone in that capacity to write a book. So the publication is technically not a book, however much it may resemble one, but is described as "A Report to the London County Council." From the report of the Special Water Committee, presented at the last meeting of the Council, we learn that directions had then been given for 500 copies of this work to be printed, and a copy sent to each member of the Council. This being done, and "the requirements of the office" having been met, the surplus volumes are to be on sale at the Council's booksellers, at 5s. each. Whether this literary speculation will meet with the approval of the Government Auditor, is perhaps just a little doubtful; it being rather a novel proceeding for a Parliamentary Agent to write a book, and for a Local Authority to print and publish it—appropriating sundry copies for its own delectation, and offering the rest for sale. The method is obviously capable of extension. We may have in the next place a portly volume on "The Position of the London Gas Companies," followed by other publications on such subjects as "The Cessation of Contracts," "The Taxability of Ground Landlords," "The Principle of Betterment," and so on, until a series constituting a regular County Council Library is duly published.

We think that it is right to refer to the manner in which this peculiar volume makes its appearance, as it is obviously intended to influence public opinion, and especially Parliament, upon an important question. The County Council have practically retained an author in their service, and hold the copyright. Mr. Cripps says in his preface: "I have prepared, as requested, notes on the position of the London Water Companies, which I submit in the following pages." Of course, Mr. Cripps must be paid for his trouble. By-and-bye, perhaps, the Council will have a Literary Department, with a salaried functionary at the head, who will indite or concoct such official lucubrations as may be demanded. For the present, a Parliamentary Agent answers the purpose; and we may allow that he has evidently bestowed a considerable amount of labour on the volume which bears his name. He modestly says that his "paper," as he terms it, is designed rather to call attention to the questions in relation to the Water Companies which the London County Council will have to consider, and to provide material for that purpose, than to pronounce "any positive opinion" upon these points. So far as "strictly legal questions are involved," Mr. Cripps further explains that he "could not pretend to express any very confident opinion without advice and assistance from counsel specially conversant with such subjects." As he had no such advice or assistance, the legal questions affecting the Water Companies are to that extent left open. Mr. Cripps also says: "I have purposely refrained from any attempt to discuss the subjects now under the consideration of the Royal Commission." So much being disavowed, it may be asked whether the book is worth the money it has cost. Our own conclusion is that the author rather under-estimates his attempts. We meet with opinions quite sufficiently emphatic; and while we admit that the author says little as to those matters which come within the domain of the Royal Commission, we yet find that the purity of the supply is not unassailed.

Although Mr. Cripps tells us he is not prepared "to express any positive opinion" upon the strictly legal points which the County Council will have to consider in debating the Metropolitan Water Question, the very first sentence of his opening chapter reads thus: "The London Water Companies have no monopoly of supply in any of their districts." Stress is laid on the circumstance that in some instances the districts assigned to the Companies overlap each other; and it is argued that Parliament intended in this way to encourage competition. The broad fact is probably this—that Parliament confided the water supply of London to sundry Companies, and left them to settle among themselves any complications as to boundary. Other water companies than those of which we are now cognizant existed in times past in the Metropolitan area; and their absorption into the present system may naturally account for some little confusion in the boundaries. Mr. Cripps himself speaks of "the difficulties which arise in determining the exact legal boundaries of the Companies' districts, owing to the method of nomenclature adopted in the various Acts." As for the idea that overlapping was purposely designed, in order to encourage competition, we need scarcely say that there are strong economical objections against two or more Companies laying their mains side by side. In arguing that the London Water Companies do not possess any monopoly, Mr. Cripps relies on the fact that there is no provision in any Act relating to the Companies which prohibits or restricts, either expressly or by implication, the introduction of new systems of supply. Possibly, had there been but one Company for all London, some such prohibition would have been expressed. It was not so easy to do this when one Company after another was set on foot, and London was gradually absorbed. But, at the utmost, the absence of prohibition cannot be taken in such a case as proof that competition was distinctly contemplated. There is no reasonable ground for doubt that each Company expected to remain undisturbed in its district, and considered the Special Act granted to it by Parliament as a virtual guarantee to this effect.

The legal position of the Companies in regard to the appropriation of water is discussed in a chapter which contains the following statement: "If the Companies claim powers to appropriate from their existing sources of supply a much larger quantity of water than they at present derive, it is possible that they may have the legal power to obtain enough in quantity both for the present and prospective requirements of London and the neighbourhood within their respective limits of supply." This would seem to be conceding so much that, on the question of an adequate quantity, little more would remain to be said. The next sentence, however, interposes another view. "But," says Mr. Cripps, "the injury said to be caused to certain districts by the exhaustion of water has produced no little remonstrance; and, should the claims of the Companies be much further pressed, there is every indication that their exercise will be strongly resisted, and the whole question of their existing legal powers may be submitted to the determination of the Courts of Law." The words "said to be" are probably introduced out of deference to the Royal Commissioners, who are clearly investigating the subject involved. The expression "may be" very carefully excludes the positive element. Mr. Cripps might well have stopped here; but he has preferred to go on with the history of the Thames Companies in its bearing upon their legal rights. Speaking of these Companies, he says: "They originally acquired by purchase or concession certain powers or privileges of supplying certain districts with water." But it is alleged that this was "at a time when all the conditions of London were totally different from those which at present prevail, and in circumstances and under conditions which have long since ceased to exist." Surely, a reference to these changing circumstances is nothing to the point, unless it can be shown that the concessions were abrogated, and the privileges taken away. For this purpose, Mr. Cripps makes what appears to us to be a perverted use of the Metropolis Water Act of 1852, concerning which he says: "Parliament, in deference to public opinion, absolutely cancelled all the privileges which had been conferred on the Chelsea, Grand Junction, Southwark and Vauxhall, and West Middlesex Companies to take water from the Thames, and forced the Companies to elect between extermination and the selection of new intakes at a part of the river then almost free from population." We utterly fail to see how a mere removal of intakes higher up the stream could cancel all the privileges "to take water from the Thames." Had the Companies been forced to draw their supply from Westmoreland or Wales, their power to abstract water from the Thames would, of course, have come to an end. But they were still allowed to take water from the Thames, only they were required to do so above Teddington Lock instead of below it. It will be observed that the Lambeth Company is omitted from the list of Companies said to have had their privileges and concessions cancelled in 1852. The fact is that the Company took the initiative in removing its intake above Teddington Lock, and, by an Act obtained in 1848, transferred the intake works to Thames Ditton, a mile or two above Kingston Bridge. Whether the change was effected voluntarily, or in compliance with the Metropolis Water Act of 1852, could make no real difference to the "concession" or "privilege" of obtaining water from the Thames. If the Chelsea, the Grand Junction, and the other Thames Companies suffered deprivation of rights, why not the Lambeth? As for any of the Companies being "forced" to establish other intakes, we presume they accepted the new condition without protest, and never conceived that their powers and privileges were being cancelled.

The Metropolis Water Act of 1871 is cited as affording some "further evidence" that Parliament regarded the legal position of the London Water Companies as "subject to modification." We should say that the principle which guided Parliament, and was embodied in the Act, was one which simply comprehended the purity of the water, and the substitution of a constant supply for the intermittent. There is no proof that Parliament was actuated by a desire to weaken the legal position of the Companies; neither did the Act produce such a result. In giving the parliamentary history of the subject, Mr. Cripps tries to make a point against the project for drawing a greatly enlarged supply of water from the chalk. He quotes from the petitions presented by the Companies in opposition to the New Supply Bill of the Metropolitan Board of Works in 1878, by which it was proposed to draw a maximum of 16 million gallons per day from the chalk formation. The petitions alleged that such a process would be injurious to the adjacent rivers and streams. If the Companies have changed their views on this subject since 1878, we may observe that the Local Authority at Spring Gardens has done the same. The Metropolitan Board had faith in deep wells; whereas the County Council, as succeeding to that body, has not. That which the former advocated, the latter resists. The one only resembles the other in a determi.

*"The Position of the London Water Companies, considered from a Parliamentary and Legal Point of View." A Report to the London County Council. By Henry Lawrence Cripps, Parliamentary Agent. London: Steel and Jones; 1892.

nation to oppose the Water Companies. But it matters little what one or the other party has said or still says. The question has reference to facts rather than opinions. The Royal Commission is now carrying on an extensive inquiry into the resources of the Thames watershed; and we hope to learn a great deal more from that quarter than from the County Council's book.

We do not know why Mr. Cripps should have burdened his pages with a review of past cholera visitations. The intakes of the London Water Companies have been removed to a point higher up the river; and the position of affairs, in regard to the purity of the stream, is entirely changed. There is something more within the proper scope of the book, when we come to the section which treats of the powers of the Companies to take water direct from the Thames, though this seems very much like going back to the argument of the second chapter. The observations in the latter portion are based on the principle laid down in the earlier part of the book—that the Companies drawing water from the Thames are doing so under concessions subject to revocation by Parliament "on the reasonable demand of the inhabitants of London." At the back of this we seem to hear the County Council saying: "We are the inhabitants." As for the principle of revocation, we have already shown its fallacy; and in like manner we repudiate anything based on such a principle. Mr. Cripps is very much at issue with the Thames Conservancy—a body not beloved by the County Council. There are certain agreements between the Conservators and the Companies, as to taking water from the river. Mr. Cripps argues against the legality of such of these as do not seem to be directly authorized by Parliament, though in so doing he comes in conflict with an award made by Sir Henry James. Mr. Cripps only admits that the Companies have power, as specified by their several Acts, to draw a total of 110 million gallons per day from the Thames, and disputes their right to the additional 20 million gallons granted under agreements with the Thames Conservancy. But the agreements appear to stand; and the award made by Sir H. James is in their favour, though Mr. Cripps ventures to think this award is not altogether so conclusive as the Conservators consider it to be.

Discussing the powers of the Companies to take water from the River Lea, Mr. Cripps says it is impossible to examine the statutory enactments dealing with this subject without perceiving their extreme complication, and the difficulty of giving them a correct interpretation. The Lea Conservancy Board consists of the unlucky number of thirteen members; and Mr. Cripps looks upon its policy with a good deal of doubt—fearing that the Companies have too much influence in its deliberations. Evidently the County Council would like to swallow up the two Conservancy Boards, as well as sundry other authorities. Leaving the rivers, Mr. Cripps proceeds to the wells, and interposes sundry arguments on technical points as to the powers of the Companies to appropriate and dispose of underground waters. This in the hands of Mr. Cripps becomes a particularly tangled subject, though it cannot be to the interest of the public that the Companies should be precluded from tapping a source of supply unquestionably pure. A very striking paragraph appears in reference to the Acts which govern the Kent Company. We thus read: "Having regard to these enactments, I think that the Kent Company have at present a legal right to derive from wells on their land as much water as they can obtain, and to use it for distribution." The charges of the London Companies come next under review; and legal decisions are cited. In the concluding chapter, we meet with some remarks reflecting on the purity of the stream; and, of course, nothing is said as to the favourable analyses of the supply by Dr. Frankland and others. The absolute power of the Legislature to modify or revoke the concessions made to the Companies is confidently insisted upon, together with the right to introduce an independent supply. The purchase of the existing water undertakings is only recommended under conditions which involve a large sacrifice of the capital that has been invested.

We do not deny that Mr. Cripps has brought together a large amount of information on the subject which he has undertaken to treat. So far we are indebted to his industry. But he has at the same time left out a mass of facts and arguments which would lead to conclusions at variance with those he has sought to establish. We do not quarrel with him on this account. The book is a County Council "Report;" and the Council would never have printed it had it not been such a report as that authority stood prepared to adopt. Holding the Council more responsible than the author, we deprecate the conduct of a public body in thus launching an elaborate attack against the London Water Companies, who in past years entered upon a task which none of the Local Authorities were then prepared to undertake. This enterprise is now perfected; so that the Metropolis has a water supply which never fails, and which has helped in a material degree to render London the healthiest of all the large cities of the world. To make it appear that the Companies which have rendered this public service—one not always profitable to themselves—have been left defenceless by the Legislature, and may be simply ignored in any future schemes, may be thought a proper way of driving a hard bargain, but is a mode of proceeding unworthy of a public authority claiming to be eminently great.

NOTES.

The Berthelot-Mahler Calorimeter.

An elaborate report upon the use of the Berthelot-Mahler calorimeter shell for testing fuels for industrial purposes appears in the *Bulletin* of the French Society for the Encouragement of Industry. It is the production of Messrs. A. Carnot and H. de Chatelier, and refers to the results of an investigation undertaken at the instigation of the Society, who had offered a prize of 3000 frs. for the most accurate determinations of the combustible power of various kinds of coal. The experiments were not confined to coal, however, but were extended to embrace fluid and gaseous combustibles. In using the shell to determine the calorific power of gas at constant volume, its capacity is first exactly gauged. It is then filled with the gas to be tested, exhausted, and again filled with the gas at atmospheric pressure. The shell is then considered to be full of pure gas. The rest of the calorimetrical operations is the same as for testing solids or fluids; the combustible being burnt in an atmosphere of compressed oxygen—the quantity of the latter being not more than sufficient to produce an explosive mixture. With ordinary coal gas, five atmospheres of oxygen are required, whereas with producer gas half an atmosphere of oxygen is sufficient. The agreement of the results obtained by the use of the Berthelot-Mahler apparatus is very perfect; thus testifying to the accuracy of the arrangement. Moreover, besides the instrument itself, only a cylinder of commercial compressed oxygen is necessary to enable a large number of experiments to be carried out; and the question of the personal skill of the operator does not play an important part in connection with the results obtained.

The Safe Flash-Point of Lamp Oil.

In the interest of the public, and of the Scotch shale-oil industry, Mr. D. R. Stewart, the Chemist to the Broxburn Oil Company, recently read a paper before the Glasgow Section of the Society of Chemical Industry on the flash-point and the heat of burning of mineral oils. Mr. Stewart accused the British Government of unduly favouring the American oil producers, at the expense of the Scotch shale-oil trade, by admitting into this country petroleum lighting oils of a dangerously low flash-point. He stated that, according to experiments instituted for the purpose of testing the connection between the flash-point of a lamp oil and its performance in lamps of the ordinary construction, it would be reasonable to insist upon a flash-point of 100° Fahr. for all lighting oils intended for consumption in the United Kingdom, which would be perfectly safe. Mr. Stewart does not agree with the conclusions of Sir Frederick Abel and Mr. Boverton Redwood, respecting the influence of a comparatively low flash-point upon lamp explosions; and he instances the fact that, while allowing oil with a lower flash-point to be sold, the Government require one of 105° Fahr. (Abel test) for War Office supplies. Lighthouse oil, again, is not permitted to flash under 145° Fahr. It is stated that Scotch paraffin oil generally flashes between 100° and 125° Fahr.; and Mr. Stewart argues that, if imported oils were required to satisfy this standard, the former would have a better chance of standing their ground. The general effect of Mr. Stewart's experiments with common petroleum oils is to show that their use is attended with greater risk than is generally supposed, especially when the atmospheric temperature exceeds 70° Fahr., as may easily happen in summer or in a heated room in winter.

Photometry by Phosphorescence.

Further particulars have transpired concerning the method of photometry by phosphorescence proposed by M. Charles Henry, which formed the subject of a recent "Note." The method depends upon the constancy of phosphorescence of sulphide of zinc prepared according to a process patented by the author. This process consists in treating with ammonia a perfectly neutral solution of pure chloride of zinc, re-dissolving the precipitate in an excess of ammonia, and completely precipitating, but without the smallest excess, the ammoniacal oxide of zinc by sulphuretted hydrogen. The amorphous sulphide of zinc, perfectly washed and dried out of contact with any impurity, is then raised to a white heat, with suitable precautions, in a porcelain crucible placed inside a graphite one. If used for photometrical purposes, the law of the loss of light by this substance being experimentally determined, it will serve for measuring very feeble illuminations, such as distant artificial light or the general luminosity of the sky. The decrease of light after the first 900 seconds being given by $i^{0.5}(t-18.5)=$ const., it is easy to calculate the luminosity at any instant. In the instrument devised by M. Henry, there are two screens of ground glass—one of them is illuminated by the phosphorescent sulphide, brought to its maximum glow at a certain time by burning magnesium ribbon, the other exposed to the source of light. It is then only necessary to wait until both screens are equally illuminated, and to note the time.

Solid Petroleum Fuel.

It is a curious exemplification of the restlessness of inventors that, while attempts are in progress to reduce solid coal to the condition of semi-fluid mud, solely for convenience of transit through pipes, equally energetic experiments are being made with the object of rendering mineral oil a solid fuel. One of the supposed advantages to be derived from the successful solidification of petroleum is declared to be that of simplifying

its transportation under conditions where the pipe-line and storeage-tank systems are found objectionable. It is reported that an encouraging degree of success has already been achieved by the Clenhall petroleum solidifying process, which consists in exposing the fluid oil, after mixing with it certain ingredients the nature of which is not disclosed, first to a moderate heat, and subsequently to a higher temperature for about an hour. The product, while still in a semi-solid state, is strongly compressed into moulds. No data are given respecting the cost of the process; but it is described as very simple, while the mysterious ingredients are stated to be common articles of trade. The point upon which the manipulators of this system lay particular stress is the superiority of solidified petroleum to steam coal as a fuel. On a trial conducted by the American company which manufactures the Clenhall fuel, it is reported that 66 lbs. of the block petroleum raised 80 gallons of water to a steam pressure of 60 lbs. in 36¼ minutes; while it took 106 lbs. of the best steam coal 60 minutes to do a similar amount of work in the same boiler. Of course, all these statements are extremely vague.

Mr. Frank C. Taylor, Manager of the Shanklin Gas Company, has been appointed Secretary, in succession to the late Mr. W. Sutherland, whose death we recorded a few weeks ago. Mr. Taylor will fill both offices.

Society of Arts.—The opening meeting of the 139th session of this Society was held on Wednesday last, when Sir R. E. Webster, Q.C., M.P., Chairman of the Council, delivered his Inaugural Address. It was devoted mainly to a review of the work of the Society in the past session, and to an explanation of the measures taken by the Council, who are the Royal Commissioners for the Chicago Exhibition, to secure an adequate representation of British interests thereat. After the address, a number of photographic views of Chicago in the past and as it is now, as well as of the Exhibition buildings, were shown by the aid of a lantern, and explained by Sir H. Trueman Wood, the Secretary of the Society. The silver medals awarded by the Council were then distributed by the Chairman; among the recipients being Professor Vivian B. Lewes, F.I.C., F.C.S., for his paper read last session, on "The Spontaneous Ignition of Coal, and its Prevention." Reference was made, in the course of the Chairman's address, to Professor Lewes's series of Cantor Lectures on "The Generation of Light from Coal Gas," the first of which was delivered last evening.

A New Filtering Material.—According to the *Engineering Record*, filters of a rather curious type are in use at the water-works at Worms. They consist of artificial stone slabs, formed by subjecting a mixture of washed river sand and silicate of lime to a very high temperature. The blocks thus prepared are about 3 ft. 4 in. square by 4 inches thick, with a slight cavity on one face. In order to use them, an area of about 2930 square feet was partitioned off from an existing filter-bed by a concrete wall. On this space 978 of the slabs of artificial stone were arranged vertically in pairs; two stones being joined with their recessed sides together, and the joint made water-tight. The slabs are extremely porous, and the filtration takes place by allowing the water to run into the basin and surround the slabs. It filters through the stones to the internal cavity, whence it is drained off to the reservoir. After running continuously for eight weeks, no diminution in the flow was experienced, nor any increase found in the number of bacteria present in the effluent. Bacteriological examinations showed that water containing 3000 microbes per cubic centimetre had only from 80 to 160 after filtration. The velocity of flow through the filters is about the same as through sand; but, owing to the slabs being placed vertically, a great area of filtering surface can be obtained in a given ground space. It is claimed that the new filters cost less, both in the matter of first establishment and for maintenance, than the old ones.

Coatings for Cast-Iron Pipes.—At the last meeting of the New England Water-Works Association, Mr. J. Garrett, of Philadelphia, in the course of some remarks on the above topic, gave a brief history of experiments with different coatings. He said the uncoated pipes first laid down in London were afterwards subjected to a wash of lime and water, applied to the interior of the pipe. In certain European cities, during the early part of the century, coatings of silicates and oxides were applied; and the pipes were treated to baths of hot oil under pressure, with the hope of preventing the tuberculous growths which formed in the interior of the pipes, and seriously impeded the flow of the water. One French method consisted in dipping the heated pipe in a hot mixture of linseed oil and beeswax; and another, tested by the French Navy, consisting of a varnish composed of sulphur, resin, gutta-percha, minum, and *blanche de céruse*, dissolved in turpentine. The latter coating was applied to a wrought-iron plate immersed in sea water, and gave good results. A rather complicated German process consisted in treating the pipe to a bath of diluted sulphuric or hydrochloric acid; and afterwards applying an under coating, at a dull red heat, of silica, borax, and soda. The upper coat, consisting of feldspar, silica, borax, oxide of tin, fluorspar, soda, and saltpetre, is applied at a white heat to the interior of the pipe; the exterior receiving a coating of coal tar before it is quite cold. In the United States, the first coated pipes used were imported in 1858; the coating being Dr. Smith's varnish.

COMMUNICATED ARTICLE.

COAL GAS: ITS MANUFACTURE, DISTRIBUTION, AND CONSUMPTION.

A Series of Articles for Gas Students.

THE PURIFICATION OF CRUDE GAS.

(*Continued from p. 727.*)

The further purification of gas by lime or oxide of iron now claims attention. The adaptability of lime for the purpose under consideration was known at a very early date; and the material was used in the form of cream of lime by Clegg. He thus introduced the system known as "wet-lime purification." Though successful as a purifying agent, the use of wet lime, owing to the very offensive nature of the refuse or fouled material, gave rise to an unmitigated nuisance in the neighbourhood of any gas-works where the process was worked; and this continued, in spite of many attempts to alleviate the trouble, for the many years during which the system was in operation, prior to the final adoption of the so-called "dry-lime" process. The latter is the one generally in use at the present day, either for the whole, or in conjunction with oxide of iron, for the partial purification of the scrubbed gas.

The lime and oxide purifiers are well known to all gas students. In form rectangular boxes, and usually constructed of cast-iron plates bolted together, they are fitted internally for tiers of wood sieves (three, four, five, or more in number, according to the requirements of the works), on which the purifying material is to be placed. The sieves are supported on T-iron bearers, which themselves rest upon lugs cast on the side plates of the floor of the box, and on standards which rise at intervals from the floor of the box, for the purpose of supporting these bearers. Outside the box, either bolted on to the side plates or cast with them in one piece, and from 4 to 6 inches away from them, is another plate, which forms with the side plates all around the box, a water channel or "lute" as it is called, varying in depth from 12 to 24 inches, or even more. Over the box is a movable cover or lid, usually of wrought iron, which, on being suspended by means of a strong ring fixed on its centre plate, can be raised or lowered at will; thus giving ready access to the purifier when required. The cover, of course, follows the form of the purifier; being a little larger all round. Its top sheets slope downwards from the centre plate towards the sides; and when the cover is in position, the side sheets are resting in the lute before mentioned. On the latter being filled with water, the purifier is provided with a hydraulic seal, which effectually prevents the escape of gas, except in the event of any stoppage in the pipes on the outlet side, in which case the gas would find a vent at that point where the least damage would be done. The inlet-pipe for the gas is fixed at the bottom of the box, and is provided with a cover, to prevent any solid matters entering the main. Permeating through the purifying material, the gas leaves the box by the outlet-pipe which is contained inside the box, and is carried up to a level above the top layer.

After being at work for a time, the purifying agent, whatever it may be, becomes "fouled"—*i.e.*, so far saturated as to be unable to satisfactorily eliminate any more impurities from the gas. When this is so, the purifier must be turned off, to be emptied and re-charged with fresh material. To stop the make of gas while this is being done would, of course, be impracticable; and so the earliest attempts at gas purification promptly indicated that arrangements must be made whereby the process might be continuous. A series of boxes is therefore provided; and the gas can be readily turned into one from another as required, without in any way interfering with the outflowing currents of gas from the retort-house. There are also other reasons for making this provision; but these will be indicated later on. For similar causes it is inexpedient, except in the smallest establishments, to work with but one purifying box in operation at a time. On the contrary, the gas is seldom allowed to enter the holders without having passed through at least three boxes, and frequently more.

This being so, the student will readily perceive the importance, not only of avoiding any cessation or stoppage in the manufacture of gas, but also of making provision whereby a dirty purifier may be promptly turned off, and as promptly turned on again when ready, without in any way disturbing the continuity of the purifying processes at work in the various boxes of the series. This is provided for and accomplished in most places by means of a "centre-valve," either hydraulic or dry, and in some works by a series of valves, or by the four-way valve that was invented by Mr. George Anderson.*

The plan advocated by Mr. Anderson, and applied by him in many of his works, is very simple, and in some respects possesses considerable advantages over the more generally adopted centre-valve system. His valve consists of an outer casing, in which works, on suitably faced top and bottom bearings, a plug which, round at these bearings, is formed into a simple diaphragm between them. From the outer casing branch off the four connections to the purifiers; the whole thus forming a +. When the valve is at work, the plug diaphragm is always in the

* *Vide* "Improvements in Apparatus employed in the Manufacture of Gas." By George Anderson. London: Walter King. 4s.

diagonal position relatively to the +. The action of the valve will best be explained by the following example: Two purifiers are to be worked, either simultaneously, or one on and one off, as may be desired. Between them will run a central gas-main, which is itself the inlet to and the outlet from the purifiers. Two four-way valves will be required. They will be fixed on this main a certain distance apart, and branch pipes will run right and left from each valve to the purifiers. We will call the latter A and B; the first valve on the central main and its diaphragm, Y; the second, *Z*; the branch pipes of Y, 1, 2, 3, and 4; those of *Z*, 5, 6, 7, and 8. Branches 1, 3, 5, and 7 are comprised in the central main; 3 and 5 being practically identical. Branches 2, 4, 6, and 8 are the right and left branches. The student is desired to make a sketch of the arrangement as thus described.

Now, the diaphragm plug being always placed diagonally with the +, it will divide it into two pairs of adjacent pipes—viz., either 1 and 2, 3 and 4, or 1 and 4, 2 and 3; similarly, 5 and 6, 7 and 8, or 5 and 8, 6 and 7. Suppose, then, that purifier A is to be No. 1; and B, No. 2. The valve Y will be turned so as to divert into branch 2 the gas entering it by branch 1; and thence through purifier A and into branch 6. The diaphragm of valve *Z* is turned similarly to Y, so that the gas is diverted from 6 to 5, then through Y from 3 to 4, and into purifier B, through which it then issues by pipes 8 and 7 into the gasholder inlet. If B is to be the first purifier, both valve diaphragms will be turned in opposite directions, and the adjacent pipes will be Nos. 1 and 4, 8 and 5, 3 and 2, 6 and 7. If A is to be turned off and B worked, valve Y will be as just described, and *Z* will direct the gas from 8 into 7 instead of into 3. If A is to be worked and not B, valve Y will be as first described, and valve *Z* as last described; the gas will therefore pass from 6 to 7, instead of to 5.

If four purifiers are to be worked, six valves will be required; the arrangement being as follows: A pair of purifiers, A and B, will be connected exactly as already described. Another pair, C and D, at the right or left of A and B, and in line with them, will be similarly connected. Between the two pairs runs a central main, which itself provides the inlet and the outlet to the series. On it are fixed the two extra valves—M and N—the four branches of which are connected as follows: Branch 1 of M is the inlet from the scrubbers; branch 2 is connected to No. 1 of valve Y, purifiers A and B; branch 3, to No. 1 of valve N; and branch 4, to No. 1 of valve Y, purifiers C and D. Branch 2 of valve N is connected with No. 7 of A and B; branch 3 is the outlet from the purifiers and the inlet to the gasholders; and branch 4 connects with No. 7 of C and D. If the student will sketch this out as directed, he will readily follow the *modus operandi* employed, and will be able to see for himself the necessary alterations of the various valves for throwing off alternately A, B, C, and D, and putting them on again when ready; each purifier, when turned on afresh, being the last to receive the gas before it leaves the series.

Sufficient has now been said to clearly indicate the method of working these valves. If the student desires further information, he should consult Mr. Anderson's work already referred to. The advantages claimed are: Greater simplicity in working than with disc-valves, and therefore less liability to error, with the attendant serious consequences; more reliability for soundness than the ordinary dry centre-valve, and much less chance of derangement, by contraction or otherwise, through alteration of temperature, with its resultant leakage of gas; and more efficiency in working, in every particular, than with hydraulic centre-valves, as well as economy of space in the purifier-house and in the connecting-pipes.

Cathels and Terrace's patent disc-valves are worked in precisely similar manner to the foregoing. They consist essentially of a circular outer case or body, provided with four outlets. Two horizontal plates—one above the other, and each containing two ports or gas-ways—divide the body of the valve into chambers, which are further subdivided by a vertical midfeather. These four chambers communicate directly, by the ports, with the outlet-pipes. A pair of disc-valves, faced on the under and upper sides to the seatings provided at the ports in the horizontal plates, are raised or lowered at will; and the ports of the upper or the lower chambers are thereby opened or closed as may be required.

Centre-valves are of two kinds—hydraulic and dry. They are designed to obviate the enormous complications in connections, valves, bye-passes, &c., that would necessarily attend the sole use of simple disc-valves. When (say) four purifiers are to be worked with a centre-valve, they will each be provided with an inlet and an outlet pipe, all of which will be brought to the valve in the centre between the four purifiers. The centre-valve is equally applicable to a series of purifiers placed in a line. The hydraulic centre-valve, invaluable in the absence of anything better, is now out of date, and ought, if it is not, to be out of use too. It consists primarily of two parts—an outer casing or tank, into which are admitted the eight pipes from the purifiers; and also the inlet and outlet pipes to and from the series. The eight pipes referred to are connected to the valve by ⊣ pipes, which stand in circular form around the inlet-pipe of the valve, and rise, as does the inlet pipe (also a ⊣), to about one-third of the height of the outer casing, which latter is filled with water nearly to this level. The lower ends of these ⊣ pipes rest in a circular tank, containing water by which they are sealed. This tank also provides a syphon, into which the whole of the purifier connections drain. Over the tops of the nine pipes in the outer casing above referred to, and sealed in the water therein contained, is a hood or cover, which communicates with the outside by a central rod or spindle passing through a stuffing-box in the outside case. The hood is internally divided into chambers, all quite distinct from one another. These divisions or chambers are such that while (say) one division connects the inlet of the valve to the inlet of the first purifier, the next one connects the outlet of the latter with the inlet of No. 2. The next chamber connects the outlet of No. 2 with the inlet of No. 3; while the outlet of No. 3 has a division all to itself, which, provided with a port through the bell cover, has direct access to the outlet-pipe of the valve. The remaining chamber simply connects the inlet and the outlet of the fourth purifier, which is thus turned "off" for emptying and re-filling. We will call the purifiers as just described A, B, C, D; A having so far been No. 1, and D off. D is now ready to put on again. The bell cover of the valve is therefore raised by the spindle sufficiently high to clear the top of the connecting-pipes; turned one quarter round, and then lowered into the water as before—thus sealing all the pipes again. The "off" compartment of the hood is now over the inlet and the outlet of A, which is thus turned off for re-charging. The inlet chamber is over the inlet-pipe of B, which has thus now become No. 1 purifier. The next chamber connects the outlet of B with the inlet of C. The outlet of C is connected with the inlet of D; while the outlet of D communicates directly, by the remaining chamber, with the outlet of the valve. When it is desired to re-start A, the bell cover will be again raised, turned one quarter round, and lowered again; B being turned off, C becoming No. 1, and A No. 3 purifier.

Many of the difficulties incidental to the use of the hydraulic valve will be obvious. The water-seal is a source of constant danger, as, in the event of any slight stoppage, it may be blown completely out without giving any notice, in which case the whole of the connecting-pipes will be in direct communication with one another. Foul gas going forward to the holder is then as unavoidable as it is undesirable. Moreover, every time the valve is changed, this admixture of gas must necessarily take place, if only momentarily; and, in the event of the change being worked at all unskilfully, it becomes a very serious matter. Hence the advantage of the dry centre-valve. In place of the cluster of pipes and water-sealed hood, this valve has a lower chamber, divided into compartments, which correspond to, and communicate with, the purifier connections, and also an upper chamber, which corresponds to the hood of the hydraulic valve. The upper surface of the lower chamber, with its dividing diaphragms, and the lower surface and diaphragms of the upper chamber, are truly planed and faced, so that the upper chamber may be freely turned on the lower one without there being the slightest quantity of gas between the two faces. In some cases these two divided chambers are enclosed in an outer case, provided with stuffing-boxes for the necessary actuating spindles, to which is fixed the outlet-pipe. The outer case provides the outlet chamber; and the action of the upper chamber is similar to that of the hood in the hydraulic valve. Further description of the working of the valve is therefore unnecessary. Provision is made for collecting all the condensation water from the purifier connections, and also for thoroughly oiling the valve. This should be done every time it is turned.

The student will have observed that provision has so far been only made for working three purifiers at a time—the fourth being off. There are now, however, in use several very good valves, which go beyond this. With them it is possible to work all four purifiers at once, or to shut off one, two, or even three, just as may be desired. The advantages of this provision in times of emergency, or for regulating the purifying area according to variations in the make of gas, and in several other directions, are very considerable. Moreover, a saving in labour and space may also thus be effected.

(To be continued.)

The "Mechanical World" Pocket Diary and Year Book for 1893.—We have received from the publishers, Messrs. Emmott and Co., Limited, of Manchester and London, a copy of the above diary, which has reached its sixth year of issue. It contains a useful collection of notes and formulæ specially compiled for the use of engineers, draughtsmen, mechanics, and others.

The Chairmanship of the Liverpool Corporation Water Committee.—Alderman T. Hughes was unanimously appointed to preside over the Liverpool Corporation Water Committee last Tuesday. In thanking his colleagues for the compliment they had paid him, he referred to several matters which would require their immediate attention—one of them being the large surplus quantity of water they possess now that they have a supply from Vyrnwy. From this source they have, he said, an available 14 million gallons a day, of which they are only using at present about 2 million gallons; and therefore they will have to find a market for the remaining 12 millions in Liverpool or elsewhere. This is very desirable, as the interest on the money expended on the scheme amounts to something like £75,000 a year, which is a very heavy burden on the present ratepayers, and one altogether out of proportion to the benefits which they can receive for some few years to come.

TECHNICAL RECORD.

AMERICAN GASLIGHT ASSOCIATION.

The Annual Meeting in Boston.

In the JOURNAL for the 8th inst., we briefly recorded the holding of the twentieth annual meeting of the above Association in Boston (Mass.), on the 19th and 20th ult., under the chairmanship of Captain W. H. WHITE, of New York, the President; and we to-day commence our usual abstract report of the proceedings.

There was an excellent attendance at the opening of the meeting; and the first business was the election of 22 new members, and about a similar number of associates. The only item in the report of the Council that aroused any discussion was a recommendation that the office of "official organ" (hitherto held by the *American Gaslight Journal*) should be abolished. This appeared to have been the result of a little friction between the Secretary and the publication in question. The Editor having undertaken to meet the wishes of the Council in the matter, the recommendation was indefinitely postponed, on the motion of Mr. Harbison (Past-President), seconded by Mr. Stiness. With regard to the proposed exhibition at Chicago, some explanations were offered by Mr. W. M'Donald, Chairman of the Committee appointed by the Association last year for the furtherance of the project; and the Committee were discharged. Mr. A. E. Boardman, of Macon (Ga.), were elected President for the ensuing year.

The President commenced his Inaugural Address by congratulating the members on the healthy position at present occupied by the Association, and also on the increased demand for gas throughout the country, which during the past year had averaged well on to 10 per cent. He thought the electricians had taught the public that a good volume of artificial light was a necessity, and not a luxury, and that the public, casting about for the most reliable and cheapest method of supplying that need, had turned to gas. Giving credit to electricians for all they had done, he insisted that gas people had not been idle. They had improved with the times; and especially had they been active in introducing gas for other than lighting purposes. In New York, it was the rule rather than the exception, when designing large or middle-class houses to provide a place for the gas cooking-stove. This had been fostered not only by the differential rates charged, but also by the steady all-round decrease in the price of gas, consequent upon the advances just instanced which had been going on. Referring to the attempts made at Cleveland, Des Moines, and Cincinnati, to cut the price of gas below a fair rate, the President pointed out the need of State Gas Commissions, similar to that in Massachusetts, as a means of securing justice in these cases; and he urged the Association to take such steps as would hasten the introduction of this needed reform. With regard to water gas, the advantage of an auxiliary plant on this system, for dealing with fluctuations in demand, was pointed out. Circumstances in each case must determine whether coal or water gas was the more advantageous to supply; and in Europe a percentage of water gas of high candle power was gradually displacing cannel coal as an enricher. The President thought that the prevailing low prices of tar were due more to the operations of a tar "ring" than to the importation of tar from abroad. In referring to the loss sustained by death of members during the year, he paid a most eloquent tribute to the memory of Mr. G. M'Ilhenny, whose decease had occurred only a few days previously.

The first paper read to the meeting was entitled "The Relations Existing between Theory and Practice;" the author being Mr. Alex. C. Humphreys, of Philadelphia. He thought there was a tendency to maintain an antagonism between theory on the one hand, and practice on the other. The scientific man was regarded as "only a theorist;" and the practical man, as ignorant and poorly equipped for his work. Carefully following out the meaning of the two words, by the aid of quotations from various authorities, Mr. Humphreys showed that this antagonism could be traced back to the ancient Greek philosophers. The "ignorant patentee" was put forward as an example of practical, but not theoretical, knowledge, who could not bring himself to recognize the worth of a training he had not himself enjoyed; and on the other side, there was the narrow-minded specialist and bookworm, full of knowledge which he could not put into practice, and too well satisfied with his own attainments to find out his ignorance. The importance of a proper appreciation of both theory and practice was next enlarged upon. The author expressed the opinion that the engineer of to-day must be well trained in each respect. There must be theoretical training in the library, and practical training in the workshop.

Discussion being invited, Mr. A. E. Boardman raised the question of whether or not a student should acquire some practical experience before going into the schools, or obtain his theory first, and then find out in the works how far practice and theory could be reconciled. In his own case, a little experience would have saved him a great deal of running after visionary and impracticable theories. Mr. A. B. Slater instanced an example of an eminent scientist taking a gas-works in hand, with disastrous results. Mr. Littehales said he considered that, in some departments (chemistry, for instance), the theoretical should precede the practical. This, he said, was also the rule in most machine-shops. Mr. Humphreys, in reply, said the proper answer to Mr. Boardman's question depended to a great extent on the nature of the student, and also upon the school or college selected. It was true that the practical man had his field, as had also the theoretical man. He had endeavoured to show that these two fields should come together, and that the successful gas manager would be the technically educated practical engineer.

Mr. G. Osius followed with a paper on the "Saving and Proper Concentration of Gas Liquor." The form of apparatus he described would convert a 2-oz. or 3-oz. into a 50-oz. or 60-oz. liquor, or give an 80-oz. product with stronger liquor. It consisted of a kind of Coffey still or rectifying column, in which liquor was admitted at the top, gradually allowed to go down, and heated at the bottom with lime, to expel the fixed ammonia. The vapour passed off at the top, and was condensed in a coil condenser immersed in cold water. The strength of the ultimate product could be varied by regulating the supply of crude liquor, and also the steam. Liquor of 60-oz. strength was the most advantageous for storeage and shipment; and it should be stored in overhead cast-iron tanks situated in a cool place, and made perfectly tight, so as to prevent loss of ammonia gas. He recommended this course as being simpler and cheaper than the manufacture of other ammoniacal products; and he thought lime might be dispensed with in small works.

Mr. W. H. Pearson, opened the discussion by inquiring why the author did not recommend anhydrous instead of concentrated liquor. Mr. C. H. Nettleton wished to know the price obtainable for 60-oz. or 80-oz liquor in Ohio or Indiana. He had used a concentrator for some five or six years with only moderately remunerative results—not more than 5d. per ton of coal carbonized. This was not so much as had been promised; but perhaps some of the profits he ought to get went into the hands of the ammonia merchants. Mr. C. J. R. Humphreys asked what was a fair return per ton of coal, where a concentrator was used. After some years' experience, he was most decidedly of opinion that the production of strong liquors was attended with considerable waste. By making aqua ammoniæ, he could get much better results. The apparatus, however, required some care; and he would not recommend it for small works. Mr. F. Egner thought it was important to work up the liquor; and he advised those who had not attended to the matter to do so at once. Mr. Irvin Butterworth said that at Columbus he made 20 lbs. of 80-oz. liquor per ton of coal, and realized from it about 1s. 0½d. He should like to know something about the future market for this product, and if the price was likely to increase. Mr. Osius, replying upon the discussion, said he did not recommend the production of anhydrous ammonia in gas-works, because it required costly and complicated plant, and great care in working. Provided proper attention was given to extracting all the ammonia in the first place, and care taken that none was wasted in the second, the returns obtained by using a concentrator would range from 8d. up to as much as 1s. 3d. per ton of coal carbonized. The yield would range from 15 to 27 lbs. of 80-oz. liquor per ton of coal. As to the future, he did not think prices would increase; but a fair and reasonable figure would always be obtainable.

Mr. F. Bredel contributed a paper entitled "Mechanical Coke Handling;" comprising a description of apparatus, with the aid of diagrams, erected by Mr. E. G. Cowdery at Milwaukee. It consists of endless chains of troughs, running on wheels, which can be connected, when required, with a driving-shaft by means of a clutch pulley. One of these, passing along in front of the retorts, conveys the coke to one end, where it may be received by a second set running at right angles, and connected with an elevator. The coke is extinguished by fixed water sprinklers. From the end of the elevator, the coke is further distributed, if necessary, by surface conveyors, consisting of troughs in which run scrapers of steel fastened to an endless chain. It can thus be delivered at any part of the yard. The coke can also be passed to a separating screen, and assorted into different sizes (in this case four), and delivered into trucks or waggons. Platform scales are provided, so that a waggon can be weighed, loaded, and again weighed in about two minutes. The author contended that, if coke was to be sold to the best advantage, it must be prepared in at least four sizes—viz., larger than 2 inches, from 1½ up to 2 inches, ½ inch to 1⅛ inches, and smaller than ½ inch. The usual practice of simply crushing or breaking coke was, he thought, not going far enough; and the use of a crusher was wasteful. The different kinds of screens now employed were noticed at some length. The one used at Milwaukee was known as the Klönne rotary separating-screen, and was 6 feet long by 3 feet in diameter. It required 1½ horse-power to run it empty, and 7 horse power when supplied with coal or coke. Running at 170 revolutions per minute, it would separate about 100 tons of coke per hour.

After reading the paper, Mr. Bredel replied to several questions on the subject. An apparatus, he said, such as he had described would not pay in a works making less than 700,000 cubic feet of gas per day; but a screen and elevator could be used with advantage in one much smaller.

(*To be continued.*)

PAINTS AND THE PAINTING OF GASHOLDERS.

At a recent Meeting of the Society of Gas Lighting, Dr. A. W. Wilkinson, of New York, read a paper on the above subject.

After a few introductory remarks in reference to the early use of paints, the author proceeded to deal with their composition. He showed that they are made from the vegetable, mineral, and animal kingdoms. The mineral paints are the most abundant and last longest. The vegetable paints furnish the most brilliant colours; but they are easily affected by exposure to light, and hence fade. The beautiful colours produced from coal tar, although more used for dyeing (yet some are used for paints), are illustrations of this class, with the exception of carbon, which is sometimes classed with mineral, and at other times with vegetable paints. The animal kingdom furnishes a few quite permanent colours; the cochineal, when dried, giving the beautiful carmine—a colour quite permanent, and much used—will illustrate this class.

It is not sufficient to have a fine powder for a pigment; it must have power to cause an oxidizing influence on the oil. The mineral paints possess this power in a greater degree than the vegetable or the animal. But they differ among themselves. Lead unquestionably stands at the head of the list. Its oxides and carbonates possess a covering power and that peculiar oxidizing influence on the oil that causes it to change to a substance not unlike amber, exceeding all other pigments. The pigment known as white lead is a mixture of the oxide. Hydrated oxide and carbonate of lead may be precipitated from the acetates or nitrates of lead; but the white lead made in this way is crystalline, and never equals that produced by the Dutch process. This is somewhat peculiar and interesting. It yields a pigment far exceeding all other white lead in quality, though the chemical composition is the same. Red oxide of lead is adulterated with brickdust and oxides of iron to such an extent that many of its valuable qualities as a pigment are lost. Zinc, when burned in the air, gives a white oxide in a very fine amorphous powder called *nihil album*—philosopher's wool and flowers of zinc, by the old chemists. It makes a very white paint, rather poor in covering properties, but possessing the good quality of not turning black with sulphuretted hydrogen, as lead will do. Hence it is often used where this gas is likely to be found. Even this pigment does not escape adulteration. Chalk, magnesia, and clay are often mixed with it, to its great injury. Iron gives many oxides, and mixtures of oxides, which are used for pigments. Pure oxide of iron makes a very desirable paint. It is the cheapest of all pigments, yields a great range of colours, and, if properly handled, gives exceedingly good results. Copper paints, from the fact that they are poisonous to all forms of life, are extensively used for the painting of ships; the ferrocyanide, acetate, and arsenite of copper being the ones most frequently used. Mercury with sulphur gives vermilion; the colour depending on the skill exercised in manufacture. When properly made, it is a permanent and brilliant pigment. The Chinese excel in its production. All the rare metals make pigments of greater or less value.

Dealing next with the oils used in paints, the author remarked that the term "drying oils" usually applied to them was an unfortunate one, as it gave the impression that they dry up like water, and leave the pigment as a residue. This, however, is not the case, as the oil undergoes an oxidizing process in the presence of the pigment and air which completely changes its character. Flax seed furnishes the greatest quantity, although drying oils are obtained from hemp seed, poppy seed, and several other sources. Oils are divided into three classes: Fixed oils, such as olive oil, lard oil, &c., which have a greasy feeling, and remain permanent even after long exposure to the air; drying oils, which absorb the oxygen, and become hard like amber; and volatile oils, which readily evaporate without change. By chemical treatment, some of the fixed oils may be made to take on drying properties; fish oil being the most commonly used. Linseed oil is expressed from the ground flax seed. As this seed is raised only to a limited extent, the quantity of oil does not equal the demand; and it is a problem at which many chemists are now working to make an oil that can be substituted for it. Cotton seed oil has been experimented with, and offers some hope of success. Fixed oils never thoroughly dry, no matter how carefully they are prepared. They give the paint a spongy or soft feeling, are greatly affected by the atmosphere, readily mildew, and soon wash off. For the purpose of making varnish and fine paints, pure linseed oil must be employed; but for ordinary painting, manufacturers feel that an adulterated oil is good enough, and pure oil can only be had by special contract. To simply mix the pigment with the oil is far from making a good paint. It should be thoroughly ground; and the more it is ground, the better the paint.

Paint is a mortar, and, like all mortars, requires a rough surface for it to adhere to. It has no affinity for the surface upon which it is applied; and if that surface be smooth and polished, we need not expect it to stick. Take, for instance, a freshly-planed pine board. How difficult it is to keep it well painted; but if the surface be exposed to the damp air for a length of time, the paint will hold much better. Some painters prefer that the wood should be exposed for a number of weeks before painting. The bright surface of tin is difficult to paint; but let it be exposed to the oxidizing influence of the air, and a superficial oxide formed, and then the paints hold well. Sheet iron forms one of the best surfaces for paint. It is not only rough, but a superficial oxide is produced in its manufacture which materially helps the oil to oxidize. The surface should be thoroughly dry; the thinnest layer of water being fatal to good painting. But the most important thing of all, and the one most frequently neglected, is the temperature. Paints will only oxidize or harden or dry at a temperature of 70° Fahr., or thereabouts. Higher than that, they become too fluid, and run from the surface; lower, they remain sticky, and after a time form a jelly-like mass, very soluble in the ammonia of the air, and easily washed off. As well might a farmer expect his seed to germinate at a lower temperature than 70° Fahr., as for a painter to expect his paints to harden to an extent that will resist the action of the air and moisture. Paints may be so prepared that they will harden at a less temperature; but it is a forced process, and makes but poor work.

The painting of gasholders is the most important of all work of this kind. Here we have an expensive piece of apparatus, made of thin iron, and subjected to the most trying conditions—the cold and frost of winter, the heat and rains of summer, every day immersed in water saturated with ammonia, and not unfrequently in oil condensed from the gas (no matter whether we make coal or oil gas). This forms a most excellent solvent for poor paint, or paint badly put on—taking the oil out of it, and leaving the pigment to be washed off by the next rain or immersion in the water of the tank. Every manufacturer of paint is sure that he has one that will give perfect satisfaction; but nine times out of ten, it is the poorest mixture that one could use. However, it is quite useless to condemn without offering a better. What, then, will give the best results, or be most likely to protect this expensive apparatus from the corroding influence of air and water? A paint formed of pure oxide of lead or iron, well ground in pure linseed oil, and put upon the holder when perfectly dry, and at the temperature of 70° Fahr., is the best protection known to science at the present day. It may be difficult to procure the oil, require some "shopping" to get the oxide of lead or iron, and entail a certain amount of trouble to have them properly ground; and it may be hard to impress upon the painters the necessity of having the holder perfectly dry, and to secure a day when the temperature is about 70° Fahr. But if all this be done, the satisfactory character and the durability of the work will well pay for the trouble.

The Petroleum Trade of Batoum.—The United States Consul at Batoum, in a recent report, enters with much detail into the history of the petroleum trade. The petroleum products of the district in 1885 amounted to 32 million gallons; and in 1891 to 268 millions. This great rise was due mainly to the increase in the volume of the production of crude oil near Baku. At the commencement of last year, there were 238 producing wells, giving daily about 72,000 barrels of 42 gallons each. In February the production rose to 106,000 barrels a day; and throughout the year the daily average was but little below 100,000 barrels. At the beginning of the present year, the number of producing wells was 315. During the past twelve months there was overproduction; and the average prices were less than the prime cost. The trade is therefore in a depressed condition. But the Consul says the people have a blind confidence and trust in the future; and accordingly the work of producing goes on at such a rate that probably the total output for the present year will be 400 million gallons. The United Kingdom took more than 46 million gallons of petroleum products from Batoum, and was the most important customer; India coming next with 39, Austria-Hungary with 32, Turkey with 24, Belgium with 22, Java with 14, China with 12, and Japan with 11 million gallons. The consumption in Russia of Batoum petroleum is only 26 million gallons.

The Destructive Distillation of Wood.—The scientific acumen and accurate observation of Professor Ramsay and his coadjutor Mr. J. C. Chorley were instrumental in presenting the industrial world in May this year with a number of interesting facts concerning the behaviour of wood when subjected to destructive distillation, which had previously escaped the notice of the many investigators in this well-worked ground. The gist of their communication was recorded in the JOURNAL (Vol. LIX., p. 914), and the paper *in extenso* may be found in the May number of the *Journal of the Society of Chemical Industry*. It will be remembered that the distillation of oak, beech, and alder was accompanied by a vigorous exothermic reaction; and the authors stated that they were continuing their observations on other forms of impure cellulose and on cotton wool (pure cellulose), to detect, if possible, the constituent of the wood responsible for the phenomenon termed, in deference to the unscientific mind, an "explosion." On Monday, the 7th inst., a supplementary note on the result of these researches was laid before the London Section of the Society. Jute and impure cotton wool (wadding) were found to behave very similarly to the woods mentioned above; but pure cellulose ("medicated" cotton wool) distilled quietly throughout, without any indication of exothermic reaction. The "explosive" properties of wood, jute, and wadding must therefore be attributed to their resinous constituents, and in no way to the cellulose. Several investigators are at present working in the direction indicated by Professor Ramsay; and to them he has formally resigned the field.

THE OPTICAL MEASUREMENT OF HIGH TEMPERATURES.

M. Le Chatelier has been experimenting upon the measurement of high temperatures by optical methods, and has communicated the results of his observations to the *Comptes Rendus*. In this report, the author refers to his successful measurement of high temperatures by means of thermo-couples, which system has been taken up in England by Professor Roberts-Austen, and is rapidly spreading in laboratories, and is even capable of doing good service in factories. There are in use, in industrial operations, however, temperatures still higher than anything that can be measured by directly exposing measuring instruments to the heat; for at such temperatures all bodies rapidly disintegrate, and consequently, if they are to be measured at all, it must be by some sort of photometrical method, in which account is taken of the different values of the radiations emitted by the heated body at different temperatures. This can be done to a considerable extent by the eye, assisted by simple standardizing apparatus. M. Le Chatelier's method is to compare the radiations of the heated body with those of the flame of a small petroleum lamp, itself standardized by comparison with a standard amyl-acetate lamp—the Hefner-Alteneck unit of light as used in Germany. A red glass placed in front of the eye-piece ensures the practical monochronism necessary for exact photometric tests. M. Le Chatelier has found the best photometrical instrument for his purpose to be that devised by M. Cornu, but modified so as to be more manageable. The photometric method of measuring heat is very sensitive; a temperature variation of from 600° to 1800° C. giving a range of luminous radiation of from 1 to 1,000,000—a graduation quite beyond the reach of thermo-electrical instruments.

Starting upon this basis, the author has ascertained that the brightest regions of the following sources, photometrically compared upon equal grounds, have the values as stated: Amyl-acetate, 1; candle flame, 1·10; Carcel lamp, 1·9; melting platinum, 5. The difficulty in the way of composing a strictly comparative scale of temperatures based upon luminosity is due to the fact that the radiation effects of an incandescent body do not depend only upon the temperature, but are affected by its chemical nature, by the physical state of the surface, and by the temperature of the surrounding space. In the particular case where the temperature of the incandescent body is the same as that of the surrounding space—a condition which practically obtains in the reverberatory furnace—the brightness depends upon the temperature only; and in the place of black substances, the brilliancy of radiation is independent of the environing temperature. Magnetic oxide of iron and carbon fulfil this latter condition. For all other bodies, a specially graduated scale is necessary.

M. Le Chatelier has effected this graduation for a certain number of bodies heated in an atmospheric gas-flame; and he reduced his results to terms of the intensity of the amyl-acetate flame. The scale of temperatures has been determined by taking the following as fixed points:—

Sulphur.	Gold.	Palladium.	Platinum.
448	1045	1500	1775

It should be remarked that the ratio between the emissive power of magnetic oxide and that of platinum varies slightly with the temperature:—

Temperature.	Magnetic Oxide.	Platinum.
600	0·00003	0·00001
800	0·003	0·00125
1000	0·08	0·03
1200	0·65	0·26
1400	3·40	1·41
1600	12·60	5·62
1800	39·00	17·00

The following bodies have for temperatures between 1000° and 1500° C., for the red radiations adopted, these approximate emissive powers: Magnetic oxide of iron and carbon, 1; palladium, 0·5; rough platinum, 0·4; polished platinum and kaolin, 0·4; magnesia, 0·1. The value obtained from magnesia is very uncertain, owing to the inevitable roughness of this body. The graduation given from the black magnetic oxide, which is taken as unity, is applicable to all bodies heated in a region of uniform temperature.

REPAIRING A DEFECTIVE RESERVOIR WALL.

At the last Meeting of the Bavarian Association of Gas and Water Engineers, Herr E. Ruoff, Manager of the municipal water-works at Regensburg, described to the members the method he adopted for repairing the cracked wall of a reservoir. His remarks were reported in the *Journal für Gasbeleuchtung;* and the following particulars in regard to the work are taken from an abstract translation of them which appeared in the *Engineering Record*.

The reservoir in question was connected with the Regensburg Water-Works. It stood about 164 feet higher than the source of the supply, was covered, and had an available capacity of 872,000 gallons. When, in May, 1891, it was emptied for the annual inspection, it was found that there were two longitudinal cracks—one in the retaining wall, on a level with the floor of the reservoir; and the other in the centre of the crown of the first arch. In order to ascertain the cause of these cracks, a narrow excavation was made to the outside of the masonry, which revealed the presence of a third crack, starting from rather above the centre of the arch wall next the embankment. So that this wall, which only approximately coincided with the natural curve of pressures, showed three cracks—two within and one without—just as the theory of arches would indicate as probable. The reservoir was built in 1874, and filled for the first time in September, 1875. The southern slope of the embankment slipped repeatedly in the spring of 1876 and 1877; and part of the earth was accordingly removed, and a terrace formed. In this way the resistance of the earth to the thrust of the arch and to the pressure of the water was somewhat reduced; and the accident may, therefore, be attributed to the following causes: In the winter of 1890-91, there was a long period of fresh, dry weather, with the thermometer at about—9° Fahr., and no snow upon the ground. The frost penetrated between 3 and 4 feet into the earth except on the slope, where it reached the reservoir wall, kept comparatively warmer by the water. The masonry of the wall was much too thin to withstand the pressure of the water within; and as the cohesion of the particles of earth was probably diminished under the existing atmospheric conditions, the resulting pressures and reactions were calculated to produce the cracks which were actually found. The pressures on the different joints was so great, however, that there was no leakage, even when the crack on the side of the arch was filled from the outside with water.

Since the fissures were not discovered until May, and must, therefore, have been comparatively old, the only course left was to prevent any further sinking of the masonry. It was at first thought that it would be necessary to build a new reservoir; but as the one already existing was not in two or more parts, so that some water could be stored during repairs, and it would have required considerable time to make another, it was finally decided to reconstruct the old one. A small provisional tank was accordingly provided, to equalize the variations in the consumption. This was built in the portion of the reservoir where the cracks occurred, close to a 12-inch dividing wall, which enabled a portion of the reservoir to be filled to a depth of 2 ft. 4 in. In this way a storeage capacity of about 52,800 gallons was obtained.

The method adopted to prevent further springing of the arches was by constructing, on a thoroughly compacted foundation, a row of 15 buttresses of concrete, which rested directly against the wall, previously well cleaned. While this work was in progress, it was found that the rubble masonry was very badly laid, especially on the lower outer parts of the wall to which the line of pressures approached closely, and that many cavities had been left. The depth of the earth embankment was also increased about 3 feet, both to augment the pressure against the wall, and to guard against any penetration of the frost to the masonry. The inner cracks were carefully cleaned and filled with cement mortar; while the outer crack was grouted with the same material. Rows of iron bolts were then inserted on the inside face of the wall, to carry the iron network forming part of an inner wall, built on the Monier system of construction, which has already been described in the JOURNAL. This network was formed of wires 0·2 to 0·28 inch thick, spaced so as to give a mesh of 2·8 inches. The wires were fastened together by smaller wires at all intersections and at the nails. The wires were then coated on both sides with cement mortar until a wall nearly 3 inches thick was formed. In order to test the value of these repairs, an oval Monier culvert, nearly 3 feet high, was built through the embankment to the masonry, in which a hole 0·7 inch in diameter was drilled as far as the Monier wall. At the time Herr Ruoff brought the matter before the Association, no water had been observed to leak through the hole, although the reservoir was filled in August, 1891. The 15 buttresses were carefully drained by pipes leading to the face of the embankment, and, like all other parts of the repairs, had given complete satisfaction. The cost of the work was only £400; while a new reservoir would have cost from £2400 to £2800.

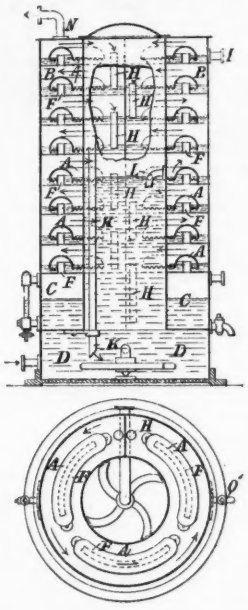
Copenhagen Gas Supply.—The consumption of gas by meter in Copenhagen during the past year amounted to 676,398,400 cubic feet, of which 441,971,800 cubic feet were sold for lighting, and 234,426,600 cubic feet for heating, cooking, and industrial purposes. The increase compared with the previous year was 122,314,100 cubic feet. The consumption of gas in the public lamps was about 65,600,000 cubic feet.

Extensions at the Manchester Corporation Gas-Works.—A few days ago the members of the Manchester Corporation Gas Committee, accompanied by Mr. C. Nickson, the Superintendent of the Department, paid a visit to the Bradford Road gas-works for the purpose of "opening" the second retort-house erected there. From information given by Mr. Alderman Hinchliffe, the Chairman of the Bradford Road Sub-Committee, we learn that the new house contains 28 beds of retorts and 488 mouthpieces; and its total producing power is expected to be 4,100,000 cubic feet per day. At present the stoking at this and the other retort-house is done by hand; but the subject of the introduction of machinery is under consideration. With the additional producing power thus provided, and with an increase to the extent of 1,500,000 cubic feet which has been made in the storeage accommodation at the Gaythorn station, it is expected that the city gas-works will be able to meet the strain that will no doubt be made upon them during the foggy days of this winter.

REGISTER OF PATENTS.

Distillation of Ammoniacal Liquor.—Feldmann, A., of Bremen, Germany. No. 18,959; Nov. 3, 1891.

This invention has for its principal object to utilize ammoniacal liquor as completely as possible, by providing that it is brought into contact with a large surface of steam, and compelled to make its way through a long series of passages—the lime chamber occupying a central position, as shown in the engraving.



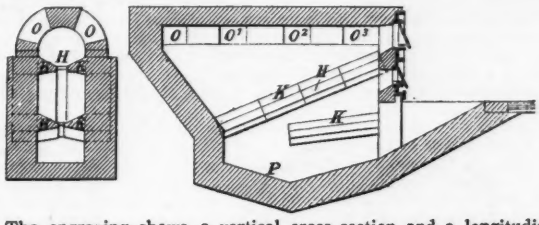
The apparatus comprises a single vessel, of circular or any other convenient section, and relatively small height. In the centre is the lime-chamber, which in its lower part takes up the whole width of the first-named vessel. In the annular portion enclosing the lime-chamber is situated (at the lowest part) a receiver or collecting receptacle C, for the residue of the ammoniacal liquor; and above it are arranged the evaporating cells or compartments B. These are of annular form, and, as a rule, provided with bells A, through which passes the steam.

The ammoniacal liquor to be treated takes the following course: The entrance occurs at I, and the bottom of the first cell is covered with the liquor to such a depth that overflow takes place through the tube H, from the first to the second cell B underneath it. In a similar way, the liquid passes from the second to the following cells. Consequently, it must in each separate cell run through the whole or part of the circumference of the vessel; and it is then brought into intimate contact with the steam issuing through the tubes F and the bells. This contact is further made effective by the fact that the distance from the edges of the bells to the vertical walls of the cells is very small; and, further, the liquor underneath the bells is acted on by the steam in its upward passage. The narrow annular cells, taken in conjunction with the steam-controlling bells or hoods, are "of great importance in effecting a complete evaporation." The liquor, which has to pass through a number of cells for driving off the volatile ammonia compounds, is discharged at K, and conducted into the lime-chamber D near the bottom. In the lime-chamber, a process of mixing takes place; and the resulting liquor rises through the tube L into the cell which is situated below the one whose contents have been led by the tube K into the lime-chamber. The liquor coming from the lime-chamber again passes through a number of cells; is exposed to the action of the steam; and finally enters the collecting space C, from which the accumulated residuals are drawn off by the cock O. The gaseous ammonia passes off through a tube N, connected with the upper portion of the main vessel or reservoir, and is drawn off for further treatment.

When an ammoniacal liquor contains only non-volatile ammonia compounds, or when the whole of the ammonia is to be treated with lime, the cells B above the milk of lime may be omitted. In this case, the liquor to be distilled passes through an aperture—the tube K being omitted—into the first distilling cell or compartment, after having been introduced into the lime vessel.

Heating Retorts.—Jones, W. R., of Rome. No. 20,677; Nov. 27, 1891.

This invention, relating to furnaces adapted for burning inferior combustibles, is especially designed for use in the heating of gas-retorts. It comprises two complete furnaces, one situated above the other; but in place of using iron fire-bars, the bed of each furnace is made with a narrow groove or slit running longitudinally along the bed of the furnace, which is composed of fire-brick blocks. The bed of the lower furnace may run the whole length of the furnace, or terminate at one-half or two-thirds the distance. Each furnace-bed is inclined; and the floor of the ashpit is also inclined, to facilitate the removal of the ashes. When the upper furnace is supplied with the coke or fuel desired, the dust and finely-divided parts of it fall through the slit on to the lower furnace-bed, and are there burned. The slit in the lower bed is preferably narrower than that in the upper bed; and the air passing over the lower bed, supplying the combustion thereon, becomes heated, and in travelling up through the upper furnace greatly assists the combustion therein.



The engraving shows a vertical cross section and a longitudinal vertical section.

H are the narrower slits running longitudinally along the furnace-bed, which is made up of blocks K of refractory material. The lower furnace is shown as extending only about two-thirds of the distance towards the back of the furnace. The upper furnace, however, extends up to the back. The furnaces are inclined towards the back; and the floor of the ashpit is also inclined (at P) towards the centre, for facilitating the removal of the ashes. The air entering below the lower furnace is heated thereby, and flows up through slit H to the upper furnace, where it is further heated; the flames passing out at the openings O, O^1, O^2, O^3, for heating the retorts or for other employment.

Rotary Gas-Exhausters.—Donkin, E. B., of Southwark Park Road, Bermondsey. No. 20,744; Nov. 28, 1891.

In rotary exhausters, pumps, engines, and meters of the general type, says the patentee, in which an axle or drum is arranged eccentrically within a cylinder or casing, and is adapted to rotate therein, and is furnished with slides or pistons adapted to travel in contact with the interior of the cylinder or casing (as, for example, in Beale's exhauster), the action is variable—depending upon the different positions of the rotating slides or pistons in relation to the inlet and outlet of the cylinder or casing; and the space occupied by the axle or drum is thus wasted. The present invention is designed to obviate these drawbacks. It consists in constructing within the axle or drum a fluid-tight chamber fitted with a piston or pistons connected to the slides or pistons first mentioned; the arrangement being such that, as the axle or drum rotates, a reciprocating movement of its contained piston, in relation to the chamber that encloses it, will take place. This chamber is placed (by suitable ports) in communication at the proper times (through suitable passages) with the interior of the main cylinder or casing near its inlet and outlet ports; and thus the machine is made more efficient and practically uniform, instead of being more or less intermittent in action.

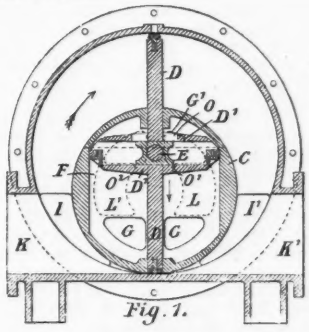


Fig. 1.

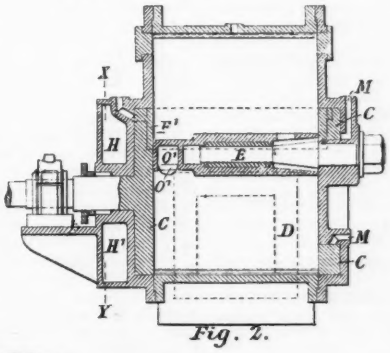


Fig. 2.

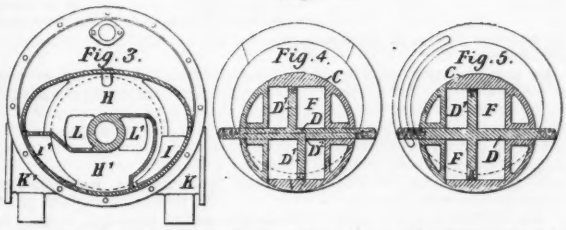


Fig. 3. Fig. 4. Fig. 5.

Fig. 1 is a central cross section; and fig. 2, a longitudinal section of such an exhauster. Fig. 3 is a transverse section (reduced size) on the line X Y of fig. 2.

The cylinder or casing of the exhauster has mounted within the end walls, an eccentrically-arranged axle or drum C, provided with a driving-shaft, and carrying the slide D that extends through the axle or drum, and closely fits the sides and inner periphery of the cylinde

or casing. E is a pin fixed to the end wall, and upon which is journalled a guide-block, which fits between extensions D^1 of the slide and serves to reciprocate this slide relatively to the axle or drum during the rotation of the latter, in a manner well understood. The axle or drum is formed with an internal chamber F, fitted with a piston that is (in the example shown) formed by extending the transverse parts D^1 of the slide, and providing them at their outer ends with packing-pieces that fit against, and so as to ensure a fluid-tight joint with, the inner surface of the chamber F, which for this purpose is made smooth. In the example shown, the chamber F is of rectangular form in cross section; and the axle or drum is provided with a removeable part, to admit of the insertion of the piston. In the end wall of the axle or drum next the left-hand wall, are formed two pairs of ports G G^1; and the wall is arranged with two chambers H H^1. I is a port by which the chamber H is placed in permanent communication with the inlet-branch K; and I^1 is a similar port, by which the chamber H^1 is placed in permanent communication with the delivery-branch K^1. L L^1 are ports formed in the end wall, and by means of which the chambers H H^1 are placed alternately in communication with the chamber F by the ports G or G^1 in the end wall. M are inlets for the lubricant; and O are openings whereby the two portions of the chamber at one side of the piston and at opposite sides of the slide D are placed in communication with each other. O^1 are similar openings for placing the other portions of the chamber at the opposite side of the piston in communication with each other.

With the construction described, when the axle or drum C is revolved by its spindle, the slide D will be caused—by the action of the pin E and guide-block—to slide to-and-fro in a transverse direction through the drum or axle; so that the outer ends thereof will be kept at all times in close contact with the interior of the cylinder or casing. The piston D^1 will consequently be caused to reciprocate within the chamber F.

Assuming the parts to be in the positions shown in fig. 1, and that the axle or drum is rotating, then, as the piston D^1 moves, fluid will be caused to enter the chamber F within the axle or drum from the inlet-branch K, by way of the port I, the chamber H, and ports L and G^1; while the fluid at the opposite side of the piston will be forced by the piston to the delivery-branch K^1, by way of the ports G and L^1, the chamber H^1, and the port I^1. When the piston D^1 moves in the reverse direction, the ports G and G^1 will have changed places relatively to the inlet and outlet ports L and L^1; so that liquid will now enter the chamber F at the other side of the piston through the ports G, while that previously drawn in through the ports G^1, will be discharged through the port L to the delivery-branch.

Fig. 4 is a view illustrating the application of the invention to the exhauster described in Gwynne and Beale's patent of 1871 No. 3449. In this case, there are two slides D D^2 that work in contact with each other, and each of which is provided with a projecting portion D^1 that forms a piston arranged to work in one-half of the chamber F, to and from which fluid is caused to flow through ports and passages formed in the end of the axle or drum C and adjacent end wall, in the manner already described.

Fig. 5 is a similar view to fig. 4, illustrating the application of the invention to the exhauster described in Beale's patent No. 1402 of 1866. In this case, there is one slide D, provided with a piston D^1, arranged to work within the chamber F in the axle or drum, in the manner explained.

Gas-Engines.—Hartley, J. W., and Kerr, J., of Kilmarnock. No. 21,496; Dec. 9, 1891.

This invention relates to the details of gas-engines; its object being "to simplify such details and increase their effectiveness in action." The invention comprises: Improvements in governing gear, and in the order of governing double-acting gas-engines; improvements in the construction and arrangement of gas-engine governors and valve-actuating linkage connecting therewith; improved details for connecting and disconnecting ignition-tubes; an improved arrangement of inlet and exhaust valve, with air-admission passage; and an arrangement of regulating-valves suitable for engines working with Dowson gas.

In carrying one part of their invention into effect, the patentees construct a double-acting "Otto cycle" gas-engine—that is, a gas-engine in which one impulse for every four single strokes is obtained on each side of the piston. Such an engine, the inventors remark, like most steam-engines, has a stuffing-box at the front end of the cylinder, through which a piston-rod passes to a crosshead. In a gas-engine so arranged, at full power two impulses are obtained for every two revolutions; and these impulses follow each other on out and in stroke, so that the fly-wheel makes one revolution, during which charging and compressing occurs and no explosion is given. In regulating such an engine, the governor and its connections are so arranged that the gas supply is cut off from one end of the cylinder first (preferably the front end); and should the speed continue to increase, the gas is cut off from the back end. In this manner, when the engine is at work and developing about one-half of its maximum power, impulses are given on one side of the piston only, and the engine runs steadily at half-power. At powers above half-power, the impulses are given to some extent on both sides of the piston, but not till the impulses are fully in action on one side.

In the governor gear used to communicate the motion of the governor sleeve to the interposing or catch-edges controlling the action of the gas-inlet valve, irregularities in the action of the governor are usually caused by the sleeve being held rigidly in one position while the catch edges are engaged. The governor, consequently, sometimes acts in a jerky manner; and the sleeve oscillates above or below its true position. To prevent this, there is interposed between the governor sleeve and the catch lever or piece, in any convenient part of the linkage, a spring-controlled slide or sleeve, arranged in the following manner: On a rod carrying the sleeve, two spiral springs are caused to press home collars to opposing shoulders. The sleeve rests between these collars; and the linkage from the governor sleeve connects to the spring-controlled sleeve, while the rod carrying the springs connects to the catch pieces or edges. If, then, the catch-pieces are engaged with the gas-valve, or gas-valve operating device, and the speed of the engine rises or falls (causing the governor balls to extend or close), the linkage moves the spring-controlled sleeve, and compresses one or other of the springs; but the opposing spring does not follow, as its collar is pressed hard against its shoulder. In this way, the governor sleeve is free to move—compressing one or other of the opposing springs; and the catch edges or levers are allowed to remain in contact with the gas-valve stem or other connection until liberated by the closing of the gas-valve.

In gas-engines used for electric light purposes, extreme steadiness is necessary; and with this object in view, the following arrangement is adopted, combining a throttle and cut-out governor: The gas cam or the catch-edges operate the gas-valve in such a manner that a certain range of movement by the governor sleeve is required before the gas is cut out; and the engine is governed during this range of movement by throttling the gas supply, which is done by connecting a lever with the governor sleeve or its linkage, and this lever connects to a butterfly or other throttle-valve placed in the gas-supply pipe. During a determined amount of speed variation, the gas supply is throttled; and thus the power of the explosions is reduced. But the throttle-valve is so arranged that the mixture may not become so dilute as to miss explosions and thus waste gas. When the desired amount of throttling is obtained, the further governing of the engine is effected by cut-out action. The throttle-valve may either be so set that it cannot be completely closed, or a bye-pass may be arranged in which the throttle acts and closes completely—the direct gas supply being adjusted by a cock or valve, to allow of the desired proportion of throttling.

In one mode of arranging a gas-engine governor, the patentees construct a bell-crank, mounted within a pulley serving as the driving-pulley. One arm of the bell-crank works in a slot, cut in a small spindle or shaft, which passes through the main spindle, and projects through it. The other arm of the bell-crank carries a weight, which works in a line radial to the centre of the pulley and within it. This weighted arm is forced or pulled towards the centre of the shaft by a spiral spring; and the spring is adjusted by a set screw, either attached to the weight or to the pulley. This provides a centrifugal governor with one weight; and this weight causes the small spindle to be moved to-and-fro in the direction of the axis of the shaft as the speed varies. The external end of the shaft carries a knife-edge groove, and the gas and air-inlet valves are coupled together by a lever, which is pivoted to the air-inlet valve stem or rod actuating it at the middle. One end presses against the gas-valve stem, while the other end has a catch or knife-edge termination, engaging with the knife-edge groove in the governor spindle when the engine is at or under its normal speed; and, the air-valve being opened, the gas-valve opens also. When the normal speed is exceeded, the governor spindle is drawn away; so that end of the lever meets with no resistance, and it simply pivots from the gas-valve spindle end, and the valve remains closed.

The ignition-tubes are arranged to screw into a seated piece, which carries the funnel and attachment; and a clamp holds down the seated piece against a seat in the engine metal. In this manner, by undoing one bolt or nut, the ignition-tube and its attachments may be renewed and replaced.

The inlet exhaust-valve is placed in the lower part of the explosion space within the cylinder, so as to dispense with the passage which usually leads from the cylinder to the valve; and the inlet-valve is in a short port at the cylinder end. From the inlet-valve, a pipe casting is led to the ground level; and then the casting is carried along the floor to the base, so as to take the air supply from the base of the engine. The air-supply casting thus serves as a stay for the back end of the cylinder, and the horizontal part serves to attach the valve-closing springs.

The arrangement for regulating-valves, principally suitable for Dowson gas, consists of a valve casing, from which a pipe leads to the engine cylinder; and the gas-valve opens into this casing when the governor causes the cylinder to take a charge of gas. Another valve (preferably of the flat type) opens into the same casing; and it is so arranged that, when the gas-valve is open, a projection from it closes the flap-valve, or prevents it from opening except to a limited extent. The flap-valve admits air (preferably from the engine-bed); and when the gas-valve is closed, an increased supply of air passes by it through the gas-passages into the engine cylinder. In this manner, the throttling which occurs in engines using Dowson gas, or any gas required in large proportional volume, is avoided, when the engine is cutting off the gas supply.

The engines are started by compressing an explosive mixture within a chamber, which has two connections, each provided with a stop-cock. The inlet-cock admits the charge from a suitable pump; the outlet being closed. When the chamber is charged, the inlet-cock is closed; and the outlet-cock is connected to the outer end of the ordinary igniting-tube. The cylinder of the engine is filled with an explosive mixture of gas and air; and when the outlet-cock is turned, the compressed explosive mixture rushes from the chamber through the incandescent tube, and ignites the main charge in the cylinder. In starting double-acting engines, both ends of the cylinder may be charged with explosive mixture. The first explosion causes the advance of the piston, and the charge at the opposite side of the piston is compressed, and a second explosion immediately follows. In starting a double-acting six-cycle engine (or a gas-engine having an intermediate air scavenging stroke), the second explosion is provided for by closing the air-inlet valve, and admitting the charge to the incandescent tube. This is done by removing an intermediate portion of the air-valve spindle, whereby the valve is closed; and at the same time the timing-valve is temporarily propped open, so as to admit the charge to the ignition-tube.

Gas Puddling-Furnaces.—Newton, H. E.; communicated from R. N. Oakman, of Greenfield (Mass.). No. 21,633; Dec. 10, 1891.

This invention relates to a double-hearth puddling-furnace, adapted to be heated by the combustion of gas and air introduced and burned under pressure, and for properly utilizing the escaping products of combustion. The object intended to be attained is to provide for heating each of the two hearths alternately by waste heat from the other hearth—that is, to provide for heating one of the hearths at one period by direct firing with gas, while the other is heated by the flame and waste products escaping from the first hearth. Then the second hearth, at the next period, is heated by direct firing, while the first is

heated by the flame and waste products from it; and so on continuously—the direction of the flame and the waste product being reversed at successive periods.

The two hearths or chambers are preferably constructed with cylindrical side walls and roofs or crowns. They are supported upon piers or columns, and are connected by an inclined or tangential flue on a plane some distance below the crown of the chambers, and preferably near the hearths. The outlet-flues are preferably constructed near the connecting-flue, on about the same level; and they extend horizontally outward a short distance, and connect with vertical downtake flues, which connect at the lower ends with a horizontal flue leading through a flue to an air-heater placed below the floor in the working room. The vertical flues have sliding dampers formed of refractory material, and adapted for tightly closing the flues.

APPLICATIONS FOR LETTERS PATENT.

19,491.—MARSLAND, I. and J. W., and HIGGINBOTHAM, J., "Automatic gas-regulator to be applied to gas-stoves for the heating of irons used by hatters, tailors, dressmakers, &c." Oct. 31.

19,606.—COLLINS, C. R., "Oil spraying or atomizing devices for gas apparatus." Nov. 1.

19,630.—GALOPIN, H., "Using liquid fuel for lighting and heating purposes." Nov. 1.

19,753.—GLASGOW, H. G., "Manufacture of water gas." Nov. 2.

19,812.—MOND, L., "Obtaining ammonia, chlorine, and hydrochloric acid from ammonium chloride." Nov. 3.

19,838.—LEEDY, J. K., "Water-supply system or apparatus." Nov. 3.

19,850.—HILTON, T., "Gas-stove." Nov. 4.

19,855.—NORMANVILLE, S. A. DE, "Lighting railway trains." Nov. 4.

19,970.—YEADON, J. A., and ADGIE, W., "Fire-bricks, retorts, and other analogous articles." Nov. 5.

19,972.—PAYNTER, F. G., "Valve or cock device for the distribution of water." Nov. 5.

19,983.—HAAS, E., "Gas-meters." Nov. 5.

19,997.—GOETZ, J., "Separating tar and ammonia from gas." Nov. 7.

20,053.—MANTRANT, U., "Gas-lamps." Nov. 7.

20,190.—PARKES, J. and J., "Carburetting apparatus for gas-lights." Nov. 9.

20,246.—COWAN, W. H., "Dry gas-meters." Nov. 10.

20,341.—FICHET, P. A., and HEURTEY, R., "Production and the use of gaseous fuels." Nov. 10.

20,342.—HOFFMANN, O., "Spraying, spreading, comminuting, feeding, and distributing oils, vapours, gases, and generally all liquids and fluids." Nov. 10.

20,343.—HOFFMANN, O., "Delivery nozzles for spraying, spreading, and disintegrating liquids." Nov. 10.

20,380.—WEEKS, J., "Joints for gas, water, and other pipes." Nov. 11.

Fatal Accident at the Bristol Gas-Works.—An inquest was held yesterday week, at the Bristol General Hospital, on the body of Thomas Greenway, aged 33, who died in that institution on Friday evening. The evidence adduced showed that the deceased had been employed by Messrs. John Aird and Sons on the gasholder tank which they are constructing for the Bristol Gas Company at Buxton Hill, some particulars concerning which were given in last week's issue. On the preceding Wednesday, he was engaged in filling skips with the earth which was being excavated; and, while in the act of stooping down to pick up a lump of dirt, he slipped and fell forward. It is supposed that a large piece of marl dropped from a skip which was being raised, as the base of the skull was fractured; but no one saw anything fall. The jury returned a verdict of "Accidental death."

Refusing to Supply Water.—At the Thames Police Court, last Wednesday, the East London Water-Works Company were summoned for neglecting to furnish Mrs. Friend, of Lonsdale Road, Barnes, the owner of Nos. 36 and 37, Marshfield Street, Cubitt Town, with a supply of water. Mr. Furbinger, barrister, who appeared in support of the summons, said it was taken out under section 43 of the Water-Works Clauses Act, 1847, because the Company refused to supply two houses with water. The water was on at these two particular houses until Oct. 10, when it was properly cut off by the Company, as a leakage existed. After that Mr. Friend, who acted for his wife, was desirous of having the water put on again; and he paid the charges asked for the connection. The Company accepted the money, and made an appointment with Mr. Friend's plumber for the purpose of putting on the water; but after that they demanded another sum of 4s. before making any connection. Mr. G. Kebbell, who represented the Company, thought the circumstances of the case were not very much in dispute. The only matter which the Company were concerned about was to open the ground for the purpose of repairing the main or cutting off the connection. The supply having been lawfully discontinued, the complainant was practically asking for a fresh supply, and would have to follow out the course indicated by section 48 of the Act. It would be absurd to suppose the Company would open up a trench of 28 feet, which they would have to do to see the state of the pipe, for 4s. Out of the sum asked, they paid the parish charges; and it was no part of the duty of the Company to reconnect. Mr. Mead inquired how long the houses had been without water; and he was told since Oct. 26. Continuing, he said that, through an ambiguous letter on the part of the Company, there had been a mistake, and eight persons had been deprived of water. It was a most serious thing to take from people their water supply; and, therefore, when the Company felt justified in pursuing that course, they ought to express themselves in the clearest terms as to what should be done. If he inflicted a penalty, the complainant would not get any benefit; and he suggested that the case should be adjourned with a view to compensation being paid. At the same time, immediate steps should be taken to reinstate the supply. Mr. Kebbell accepted his Worship's suggestion, and said the question of compensation would be considered by the Company.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by correspondents.*]

The Use of Sprayed Oil as an Enricher.

SIR,—I notice, in the JOURNAL for the 1st inst. (p. 770), an article on the use of petroleum oil in place of cannel coal, as carried on by Mr. R. Herring, of the Dover Gas-Works. Up to the present time I have been very quiet about this matter; but I cannot allow Mr. Herring to go any farther without informing all gas managers that he has deliberately robbed me of the credit, so far as he could, of what I chose to show and tell him respecting my process of enriching common coal gas with oil. Some three years ago, Mr. Herring paid me a special visit for the purpose of ascertaining my method of enrichment which I had then had in constant use at the Carshalton Gas-Works for about two years. On Mr. Herring's promise that he would lay the matter before his Directors, and let me know the result, I gave him sufficient information to enable him to make a trial. Since that time I have had no reply until this week, when I wrote to his Directors, and have received an answer stating that Mr. Herring read my letter to them, which I sent soon after his visit to me; but, as they were perfectly satisfied with what he was then doing, they declined my offer. This is, to say the least, a very crude way of getting out of what I regard as a strange transaction. But I can hardly think the Directors would have countenanced such a proceeding had they known the truth of the matter; and I must say that it appears to me to be great neglect on their part not to have caused a letter to be sent to me, informing me of the decision to which they had come.

It will be remembered by the members of the Southern District Association of Gas Managers that Mr. Herring, after I had written to him not to do so, read a paper before them upon the subject of oil *versus* cannel coal; and I here wish to thank Mr. Helps, the Engineer of the Croydon Gas Company, and Secretary of the Association, for the part he took on my behalf—he knowing well that Mr. Herring's process was a copy of mine.

I may state that the particulars supplied to you by Mr. Herring are misleading to any manager who wishes to try the process. In the first place, the ordinary ¾-inch cock is decidedly an error; secondly, the constant pressure is also an error. The first-named arrangement lets a great part of the oil down at the mouthpiece; and what goes forward being at an equal pressure, is thrown in one place, instead of being distributed over the whole surface of the hot coke. This accounts for the more than necessary quantity of oil used by Mr. Herring.

For the information of gas companies, I may say that I have just taken out the whole quantity of oil I have used in the five years during which my process has been at work; and it amounts to a trifle less than 4 gallons to 10 tons of coal carbonized—keeping my gas on the average up to 16-candle power. If I were to use a gallon to every ton of coal, as Mr. Herring does, my gas would certainly be up to 18 candles, and even more.

I must apologize for taking up so much of your space; but I think the gas profession should know precisely how matters stand.

Carshalton, Nov. 12, 1892. R. GOOD.

The Quality of the Water Supply in South London.

SIR,—In your issue of the 15th inst., a paragraph appeared stating that "Dr. R. Bodmer, the Medical Officer of Health to the St. Saviour's District Board of Works, persists in complaining that the water supplied by the Lambeth and Southwark and Vauxhall Companies is of unsatisfactory purity." Permit me to point out that the Medical Officer to that Board is Dr. James Herron, and that the R. Bodmer referred to is the Public Analyst to the Board.

In September last I reported unfavourably on samples of water taken from the mains of the two Companies above named. Dr. Frankland certainly reported favourably on the general condition of the water supplies for September; but none of the samples analyzed by him were taken at the same time or place as those on which my report was based. Dr. Frankland, however, in his September report, refers to the large number of colonies of bacteria developed in the water taken from one of the filtering-beds of the Southwark and Vauxhall Company; indicating that this particular filter was not doing its work properly. In October I reported that the condition of the supplies of the two Companies was "still unsatisfactory." Only a few days ago the *Daily Telegraph* gave an extract from Dr. Frankland's report for October, in which, so far from saying the water was of good quality, as you make out, he reported that all the Thames-derived supplies were *bad*, both from a chemical and a bacteriological point of view. I may also state that my analyses do not stand alone. On frequent occasions during the year now closing, the Analyst for Battersea has reported most unfavourably on the supplies of both Companies. I am quite aware that, during the autumn and winter, such a high degree of purity as that attained to in summer cannot be expected; but on that account I maintain that extra precautions should be taken by the Water Companies in filtering and purifying the water during that time of the year. As to the application of the St. Saviour's Board to the London County Council, referred to in the same issue of the JOURNAL, I may say I was not in any way consulted in the matter.

In conclusion, I beg to state that I am the last person to discredit Dr. Frankland's analyses; and I am of opinion that the discrepancies that occur between his reports and those of other analysts would not appear if identical samples of water were examined by all.

16, *Southwark Street, S.E.*, *Nov.* 18, 1892. R. BODMER, F.I.C., F.C.S., Public Analyst for St. Saviour's.

The Dangers of Oil-Lamps.—Owing, it is stated, to the upsetting of an oil-lamp, a serious fire broke out last Thursday week at No. 6, Mare Street, Hackney. The shop and house of eight rooms were completely ablaze when the firemen were called up by the ringing of the alarm; and, in the result, the entire premises were gutted. Three adjoining houses suffered considerable damage.

LEGAL INTELLIGENCE.

ULVERSTON POLICE COURT.—Thursday, Nov. 3.

(*Before Captain* GALE, *Chairman, and Messrs.* AINSLIE *and* DICKSON.)

Ulverston Local Board v. Walker.—Disputed Gas Account and Meter Registration.

To-day the Bench were occupied for a considerable time with proceedings arising out of a summons taken out by the Ulverston Local Board against Mr. E. Walker, of Poplar Grove, Ulverston, for the payment of £4 14s. 2d., the balance of a gas account for the quarter ending in March last. The case excited great interest.

Mr. J. POOLE, Clerk to the Board, appeared in support of the summons; Mr. WALKER conducted his own defence.

Mr. POOLE, in opening the case, explained that the defendant's gas bill for the quarter in question was £9 10s. 1d., towards which he had paid £4 15s. 11d.; leaving in abeyance the amount now in dispute. Mr. Walker had objected that he could not possibly have consumed the gas for which he had been charged. But it appeared he had in his house two gas-fires and lights in the various rooms; and the Bench knew how extensively gas might be used when left in the charge of servants. He had no doubt the defendant had actually burnt the gas for which he had been charged. But, so far as the Local Board were concerned, the simple question was whether the meter was correct. It had been sent to a meter inspector at Edinburgh, who had certified that it was right. It was 0·5 per cent. too fast, but the Sale of Gas Act, 1859, allowed it to be 2 per cent. fast or 3 per cent. slow. Since then it had also been inspected by a Manchester gentleman. He (Mr. Poole) submitted that, if that inspector differed from the other, the meter should, as provided by the Act, be sent to the district inspector appointed by the Quarter Sessions; and if his certificate was disputed, the assistance of two inspectors from the adjoining district might be sought.

Mr. WALKER said he was never a party to the meter being sent to Edinburgh. It had been out of his possession for six months; and it was not now in the same condition as when it was taken away from his house. He therefore objected to any further inspection. The Gas-Works Clauses Act, 1871, gave full power to the Justices to adjudicate, and settle the dispute.

Mr. POOLE said he would prove that the meter had not been tampered with in any way whatever. He might say that the defendant had had a new meter put in, with which he believed he was also dissatisfied.

After a good deal of argument between the parties, the Bench decided to hear the evidence.

Roper Robinson, meter inspector in the service of the Local Board, testified that he took the state of the defendant's meter on the 22nd of March last, and it showed a consumption for the quarter of 54,300 cubic feet, which, at 3s. 6d. per 1000 feet, came to £9 10s. 1d.

Mr. *J. Swan*, Gas Manager to the Board, said the meter was duly stamped. The defendant disputed his account for gas for the March quarter; and on the 28th of April, on the defendant's suggestion that it should be tested, it was sent to Edinburgh to Messrs. Alder and Mackay, the makers, with a request to hand it to the district meter inspector for testing. This was done because he (Mr. Swan) did not know the inspector's address. It was impossible for anyone to tamper with the meter without breaking the Government stamp. Since the previous Thursday the meter had been sent to a Manchester inspector; and the same stamp was on it.

Cross-examined by defendant: I know how your house is fitted up with gas. I will swear the register of the meter proves that you have had 54,300 cubic feet of gas for your money. It is true that the two gas-fires would have to be going about 10 hours a day to burn 32,000 cubic feet in the quarter, and that this would leave 22,300 feet for illuminating purposes. At the time we had a conversation to this effect, it was agreed that the meter should be changed. A new one was put in on the 26th of April. I will swear the meter came back from Edinburgh in the same condition as when it left your house.

Mr. WALKER then asked for the meter to be produced; and it was sent for and brought into Court.

Mr. POOLE read the Edinburgh inspector's letter, which stated that the meter was correct, and that it had been re-stamped.

Mr. POOLE said this closed his case, as far as he could then go with it.

Mr. WALKER, in his address to the Bench, said that, during the two years he had had the meter in question in his house, he had been struck with the large amount of his quarterly gas bills; the total for the past year falling only 30s. below the actual rent. When, however, he received an account for 54,300 cubic feet of gas, he thought it time to impugn the correctness of the meter. On a most liberal calculation, he reckoned that he had not consumed a greater quantity of gas than was represented by the sum of £4 15s. 11d. He might say that altogether he had 13 gas-burners and two gas-fires in the house; but not more than five or six of the burners were used at any one time.

In answer to the Bench, Mr. *Swan* said the minimum quantity of gas the meter would pass per hour was 30 cubic feet; but, working at its full capacity, about double this quantity would go through. The gas-fires burnt 18 cubic feet per hour each.

Mr. DICKSON suggested that the parties should endeavour to arrive at a settlement.

Mr. WALKER said he had two or three times, before coming into Court, suggested an amicable arrangement.

Mr. POOLE said it was quite impossible for him to make any settlement which would raise a question as to the correctness of the meter.

The CHAIRMAN: We need not raise that question at all.

Mr. POOLE: But it must be so; and if you go against me, I shall feel bound to appeal to the Quarter Sessions.

The MAGISTRATES' CLERK: The amended Act says two Justices have a right to determine such a dispute, subject to appeal.

Mr. POOLE: But I have a right under the other Act to send the meter to another inspector.

Mr. WALKER: Not now, I submit.

The CLERK said the difficulty would have been avoided if either of the parties had taken the proper course at first. However, this had not been done; and now, if Mr. Walker gave any reason for showing that the meter was wrong, the Magistrates had power to determine the matter.

Mr. DICKSON said a suspicion had been raised by the sending of the meter to the makers in the first instance.

Mr. POOLE said he would ask for the case to be adjourned for the production of Messrs. Alder and Mackay, as a charge of fraud had been made. Mr. Walker had stated that the meter had been interfered with.

Mr. WALKER: I simply say it is not in the same condition now as when it left my house.

Mr. *J. Urquhart*, Meter Inspector for the Manchester City Justices, was then called. He explained that the Sale of Gas Act gave meter inspectors no power, in testing meters, to examine the mechanism that worked the index. This was an omission of which the Board of Trade were aware, and which he believed would be remedied in the next Act. Therefore, while a meter might pass through the correct quantity of gas, it might be wrongly indexed. In testing this meter, he passed through it 2 cubic feet of gas; and on this test the index dials would not be verified. The certificate did not indicate that the index was correct, but it complied with the Act. His examination of the meter in question showed that it was 1 per cent. in favour of Mr. Walker.

Mr. *W. Fergusson*, Gas Engineer to the Barrow Corporation, agreed with the preceding witness that the system of testing provided by the Act did not show whether or not the indexing mechanism of a meter was correct.

The Court then adjourned.

Thursday, Nov. 10.

At the resumption of the hearing to-day, a compromise was again suggested.

Mr. POOLE repeated that he could not agree to a settlement; Mr. Walker having made a charge that the meter had been tampered with. The meter was *primâ facie* evidence as to the quantity of gas consumed; and it was for Mr. Walker to show that it was wrong.

Robert Longmire was then called by the defendant, and gave evidence as to the quantity of gas generally consumed in the house. He said that, as a rule, six burners were used, each passing 4 cubic feet of gas per hour.

Dr. *Anderson* said he did not think Mr. Walker burnt more gas than he did; and his bill for the quarter in question was £2 15s.

Roper Robinson was recalled, and gave particulars as to Mr. Walker's consumption of gas at various periods. He said it appeared from the card that Mr. Walker's gas consumption from June 22 to Sept. 23, 1891, was 10,400 cubic feet, and from June 22 to Oct. 14, 1892, 15,500 feet.

Mr. DICKSON: What is the effect of this evidence?

Mr. WALKER: It has been set up by Mr. Poole that since the new meter was put in it shows a larger consumption for the corresponding period than the old one; but the increase of 5100 cubic feet is accounted for by a difference of 23 days extra, and shows that I have just been consuming at a normal rate.

Mr. POOLE: But this decrease is after the dispute arose?

Mr. WALKER: Yes; after the new meter was put in.

Witness, in answer to Mr. POOLE, said the consumption for the March quarter, 1891, was 41,300 cubic feet, as compared with 54,300 cubic feet for the corresponding quarter of this year. These figures were according to the old meter.

Mr. WALKER (to witness): According to your own figures, the new meter shows a consumption of but 23,900 cubic feet for the seven months ended Oct. 14 last. What was the consumption for the three months ending December, 1891?

Witness: 34,600 cubic feet.

That is 19,100 cubic feet less than I am shown to have burnt in the next three months?—Yes. For the quarter ended December, 1890, the consumption was 33,900 cubic feet.

Mr. POOLE: We say it was the introduction of the gas-fires in October that caused the large increase complained of.

Mr. WALKER: The evidence does not show that. Mr. Swan swears that the average capacity of each gas-fire is 18 cubic feet per hour, and in my calculation I have allowed 20 cubic feet.

The point having been raised as to whether or not the defendant was entitled to give evidence,

Mr. POOLE said he had no objection to him doing so. The case had taken such a turn as to involve the general question of the incorrectness of the meters throughout the Board's district; and they might next have every gas consumer objecting to his account.

The CLERK: I do not think that follows. This may be but one faulty meter out of hundreds.

Mr. POOLE said his case was that the meter was correct. The meter inspector from Manchester, called by Mr. Walker, had practically admitted that.

The CLERK: The meter is correct according to the Sale of Gas Act; but the question as to the accuracy of the registering mechanism, which it appears there is no power given under the Act to test, no doubt raises a very big issue throughout not only this district, but the whole country.

Mr. POOLE: But that, I submit, is not the question now before the Bench. The meters are bound to be tested under the Act of 1859.

Mr. WALKER contended that Mr. POOLE could not rely upon that Act, inasmuch as its provisions had not been adopted by the county.

After considerable argument,

Mr. POOLE said he did not care about the Act of 1859. The Local Board's Act stated that the meter should be accepted as *primâ facie* evidence of the quantity of gas consumed.

The CLERK: And the General Act of 1847 says that the question in dispute shall be determined by two Justices.

Mr. *Walker* then gave evidence in support of his previous contention that the quantity of gas registered by his meter was in excess of that which had been consumed.

Mr. *J. Bennett*, of the firm of Messrs. Alder and Mackay, the makers of the meter, said he had not the slightest doubt that the meter produced had correctly measured the quantity of gas consumed by the defendant. With two gas-fires and six burners, he should say it was

quite a possible thing to burn over 54,000 cubic feet of gas in a quarter. The consumption depended very largely on the amount of pressure. The meter could not possibly register more gas than actually went through it. It was capable of passing even treble its nominal quantity of 30 cubic feet per hour. He was certain the meter was never interfered with before being handed to the inspector.

In cross-examination, witness said it was possible to take off the top of a meter without breaking the official seal. He believed the solderings of the meter in question were in the same state now as in 1884, when it was passed; but he would not swear positively that they had not been touched. It had long been suggested that the indices of meters sent to be tested should be examined; but the difficulties in the way were such that the Board of Trade had refrained from carrying this into effect.

Mr. *M. Burney*, Sub-Inspector of Meters, at Edinburgh, said the meter produced was handed to him on the 3rd of May. It had the official stamp of 1884 unbroken when he received it. He put the meter through the test specified by the Act, and found it to be 0·5 per cent. fast. He gave a certificate to this effect, and re-stamped the meter as correct. In his opinion, the meter had not been interfered with in any way. He would not swear that the consumption given for the quarter in question was possible, because he had no control over the gearing of the index. Had no power under the Act to examine that; and he had no proof that the index was correct.

Mr. *Swan*, recalled, said the meter was never interfered with while in his possession. He had calculated that the gas-fires would each burn 18 cubic feet of gas per hour at the day pressure. At night they would consume a great deal more. The difference between the day and night pressure was 7-10ths. He was quite sure the meter registered the quantity of gas charged for. He considered that the new meter put in bore that out.

Mr. *Fergusson* was recalled at the request of the Bench, and stated that, in his opinion, the ordinary burners in Mr. Walker's house would pass from 3 to 6 cubic feet of gas per hour, according to the size. The nursery gas-stove would not burn more than 15 cubic feet per hour at a pressure of 12-10ths; and the larger stove about 20 cubic feet per hour. He did not think this pressure would be exceeded at any time.

The Magistrates deliberated in private for some time. On returning into Court,

The CHAIRMAN said that, having very carefully considered the case, and Mr. Walker's estimate of the actual consumption of gas, they had come to the conclusion that he had already paid more than they considered was a proper charge; and therefore the summons would be dismissed, with costs against the Local Board.

A Water Supply Scheme for Roumania.—A competition is being opened, until the 1st of January next, by the civil authorities of Targu-Ocna, Roumania, for the best project for the establishment of a water supply to the town. An award of £200 will be given to the best scheme.

The Barnet Local Board and Electric Lighting.—The Barnet Local Board are not deterred, by the trouble they experienced with their late electric lighting contractor, from making another attempt to have this system of illumination installed in the town; but this time they mean to have more control over the work. They have accordingly intimated their intention of applying to the Board of Trade for the necessary Provisional Order to authorize them to supply electricity for public and private purposes within their district.

A New Gasholder at Truro.—On Monday last week, the inauguration of a new gasholder took place at the Truro Gas-Works; the ceremony of turning the inlet-valve being performed by the respected Chairman of the Company (Mr. R. Tweedy) in the presence of the Directors, the Manager and Secretary (Mr. W. E. Kilminster), Mr. H. Willey, jun., representing the contractors (Messrs. Willey and Co., of Exeter), and other friends. The holder has a capacity of 65,000 cubic feet; the tank contains 460,000 gallons of water; and the total weight of iron used in the structure was 250 tons.

The Purchase of the Barnoldswick Gas-Works by the Local Board—A meeting was held at Barnoldswick last Friday week, for the purpose of obtaining the sanction of the ratepayers to a Bill promoted by the Local Board, for authorizing them to purchase the works of the Gas Company, and to make better provision for the health and government of the district. The Clerk (Mr. C. Thornton) stated that the Board had had the works valued, with the result that £14,694 was the price put upon them. The Board had proposed to pay the sum of £13,850. The necessary resolution was carried.

General Gas Company of France.—The report on the working of the above Company (of which M. Albert Ellissen is the General Manager) in the year ending June 30 last, which was presented to the shareholders at the annual meeting on the 29th ult., opened with the statement that a fresh concession had been granted by the municipal authorities of Périgueux to the Gas Company in that town, and that the concessions in other places in Belgium and France had been prolonged. These results were not attained without some sacrifice, in the shape of a reduction in the charge for gas; but the Directors pointed out that the lowering of the price might be fully expected to lead to increased consumption, which would in time compensate for the falling off in the receipts. The accounts accompanying the report showed that the Company's invested capital at the close of the past financial year amounted to 36,211,257 frs., of which 14,025,872 frs. had been spent on works, and 22,185,385 frs. in the acquisition of shares in various gas undertakings. At the corresponding period in 1891, the total was 36,022,673 frs. The profit realized was 2,639,526 frs., as compared with 2,818,147 frs. in the year 1890-91. Adding the balance brought forward (122,155 frs.), there was a total of 2,761,681 frs. After deducting the general expenses, interest, additions to the reserve and sinking funds, Directors' fees, and other charges, there was left a balance of 338,790 frs. From this it was proposed to take 250,000 frs. for division; leaving 88,790 frs. to be carried forward. The dividend proposed was, as before, 31 frs. 25 c. per share; and this was agreed to. The statutory reserve amounted on June 30 last to 760,750 frs.

MISCELLANEOUS NEWS.

PRESENTATIONS TO MR. AND MRS. M'GILCHRIST.

The members of the Committee of the North British Association of Gas Managers, together with a number of friends, met in Macrae's Victoria Hotel, Glasgow, last Wednesday, to present his portrait to Mr. James M'Gilchrist, of Dumbarton, as a recognition of his services in connection with the Murdoch Memorial Fund. The resolution to thus honour Mr. M'Gilchrist was, it will be remembered, adopted by the members before they separated at Stirling on the day when the bust of Murdoch was placed in the Wallace Monument. It was left in the hands of the Committee to carry out the resolution; and they secured the services of Mr. J. S. Stewart, of Glasgow, an artist of great experience in portrait painting, who produced a most excellent likeness, in oil, of Mr. M'Gilchrist. An inscription upon the frame stated that it was "Presented to James M'Gilchrist, Esq., Gas Engineer, Dumbarton, by the North British Association of Gas Managers, 1892." The Committee resolved that, along with the portrait, a presentation should be made to Mrs. M'Gilchrist; and they selected for her a gold diamond bracelet and a very handsome silver tea service, on the salver of which was the inscription: "Presented to Mrs. James M'Gilchrist, Dumbarton, by the North British Association of Gas Managers, 1892." The ceremony at the presentation took the form of a banquet, at which the President (Mr. T. D. Hall, of Montrose) occupied the chair, and Mr. G. R. Hislop, of Paisley, was Vice-Chairman.

The PRESIDENT said he was sure the Committee must be very much gratified to see such a representation of their craft in the room, particularly when they considered that November was the very worst month in the year in which they could possibly leave their duties. It was on account of this that they had one or two apologies for non-attendance. Mr. Robertson, of Bathgate, an ex-President, wrote that nothing would have given him greater pleasure than to be present on the occasion of a presentation to one who deserved it so much as did Mr. M'Gilchrist. Mr. John M'Crae, of Dundee, wrote that he was detained by business. Mr. S. Stewart, of Greenock, Mr. A. Stewart and Mr. J. Stewart, of Glasgow, Mr. A. Bell, of Peebles, Mr. P. Watson, of Stirling, Mr. J Learmont, of Milngavie, and Mr. D. Terrace, of Middlesbrough, also wrote regretting their absence, and expressing the most kindly feelings towards Mr. and Mrs. M'Gilchrist.

The loyal toasts having been honoured,

The PRESIDENT said that Mr. M'Gilchrist, as Secretary and Treasurer of the Murdoch Memorial Fund for the last eleven years, had carried out his duties with an energy and an ability that few men could have shown. Most of those present were at Stirling when the bust of Murdoch was unveiled in the Wallace Monument; and they were pleased that Mr. M'Gilchrist had been successful in bringing the scheme to that issue. They hoped he would be spared to continue his labours, in order that he might bring the object for which he was working to its desired accomplishment, which was the establishment of a bursary that would, in a more substantial way, perpetuate the memory of so worthy a man as William Murdoch. In order to mark their appreciation of Mr. M'Gilchrist's energies, and the success that had attended his work, the Association decided to ask him to sit for his portrait, so that they might, in a tangible way, show their sense of the value of his efforts. All those who had been privileged to see the very fine painting which had been produced would, he was sure, congratulate the artist on his having secured and fixed Mr. M'Gilchrist in one of his everlasting genial smiles. He did not know, and he did not wish to know, what the Association would be without Mr. M'Gilchrist. They had only to hear him speak to be smitten with his geniality and enthusiasm.

Mr. A. MACPHERSON (Kirkcaldy), in making the presentation, said that when they looked on Mr. M'Gilchrist as a gas engineer, they acknowledged his eminence in his profession; and when they looked on him as a friend or an organizer, they found him to be unapproachable. They all knew how kind he was, as a gas engineer, to his neighbours; for he was ever ready to help them with his advice. No one had the slightest doubt as to approaching Mr. M'Gilchrist at any time; and all who had done so could testify to their being always received in the happiest and kindliest manner possible. No truer friendships had been formed anywhere than those which had been formed with Mr. M'Gilchrist as a member, not only of the North British Association, but of the West of Scotland Association in its day, and of The Gas Institute. Mr. M'Gilchrist was a great favourite in Scotland; but he was as great a one among his brethren in England. He was sure there was not another gas engineer who could draw such attendances as Mr. M'Gilchrist did to their informal meetings in the spring. He had been for years pegging away at the Murdoch Memorial Fund with a determination that none of them could equal, resolved to bring it to a successful issue. He had so far succeeded that they had been able to place a most admirable bust of Murdoch in the Wallace Monument. But Mr. M'Gilchrist's enthusiasm did not stop there; and, privately as well as publicly, he had expressed his determination that the bursary scheme should succeed—a scheme which would be worthy of the name of Murdoch. There need be no hesitation in saying that, when Mr. M'Gilchrist put his shoulder to the wheel, the wheel must move round till it came to where he wanted it. He (Mr. MacPherson) might therefore say that the Murdoch bursary was guaranteed. In their own Association, Mr. M'Gilchrist had given great assistance to all the officials; he had also been a most liberal contributor of papers, by which they had all profited, and which reflected the highest credit on their author. It afforded him the greatest pleasure to make the presentation. But there was a more peculiar pleasure reserved for him in being asked to convey to Mrs. M'Gilchrist the tokens of their respect and esteem which were before him; for all who were acquainted with her respected and esteemed her as a most worthy lady.

The portrait was then unveiled, amid applause; and the other presents having been uncovered, Mr. MacPherson formally presented them to Mr. M'Gilchrist, with the expression of the good-will of the members of the Association, and the hope that Mr. and Mrs. M'Gilchrist

might be long spared to enjoy them. He then proposed the health of Mr. M'Gilchrist, which was responded to heartily; the usual honours following.

Mr. M'GILCHRIST, in acknowledging the presentation, said he had certainly a very pleasant duty to perform in thanking them, on behalf of himself and his wife, both for the gifts and for the very kind way that Mr. MacPherson had expressed himself towards them. He could assure them that he appreciated their kindness very, very highly; and he was much pleased that his professional brethren had thought him worthy of such a handsome testimonial. With regard to the Murdoch bursary, he might say that it had taken ten years to bring the fund up to the present sum; but he thought that in less than that time they would be able to establish a bursary worthy of the name of William Murdoch. Unfortunately, Murdoch's fame was not generally known; otherwise credit would have been given to that great inventor long before this—the centenary of gas lighting. He (Mr. M'Gilchrist) had spent the happiest years of his life in connection with Gas Associations and gas managers; and he was really at a loss to know how the North British Association at this time favoured him with such a presentation. But the articles which had been presented to him and his wife would pass down to his successors as heirlooms, and be looked upon by them with pride as being tokens of the great kindness shown to their ancestor by his colleagues.

The other toasts were: "The North British Association of Gas Managers," proposed by Mr. R. Sutherland (Glasgow), and responded to by the President; "The Health of Mr. Carlow, the Secretary and Treasurer of the Association;" "The Artist;" "The Chairman;" "The Trades Associated with the Gas Industry;" and "The Health of Mr. MacPherson."

ORIENTAL GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Wednesday, at No. 14, St. Mary Axe, E.C.—Mr. H. M'LAUCHLAN BACKLER in the chair.

The SECRETARY (Mr. J. G. Drew) read the notice convening the meeting; and the Directors' report and the statement of accounts (see *ante*, p. 820) were taken as read.

The CHAIRMAN said the accounts submitted showed that during the year they had had the means of reducing some of the expenses—in a slight degree, it was true, because they were already very small; but, at the same time, with an increase of rental such as they had, they could not expect to have reduced them very materially. The main feature of the accounts struck one at once—viz., that, notwithstanding the average charges on the profits had been reduced, they still had a considerably less amount of profit than last year; the difference being £6787. Now, although this was the case, the amount against the profit under one item alone—viz., exchange—was £7636 more than in the preceding year. As regarded the working of the Company and the expenses, those were matters over which they had the mastery, and which the Directors exercised as well as they could on this side, and they believed that every economy was exercised on the other side. But respecting the rate of exchange, that was a matter in which they were perfectly helpless; and they must submit to the state of affairs as they found them. Of course, they regretted this very much; but still there it was, and they must bear it. Nevertheless, the shareholders would see the Directors were able to recommend the same dividend as last year, and leave the amount of undivided profits at £12,319, which might help them on some future occasion if the exchange should be still further against the Company. Whether or not it would be so, it was impossible for him to predict; but certainly at present things did not look very bright. He had no doubt the shareholders would have noticed that the reserve stood at the same figure as last year, when they added £2000 to it. Now that it had reached more than 10 per cent. of the capital, the Directors thought that, when they came to a time such as the present, when the concern was not so prosperous as it had been, owing mainly—and he might say entirely—to the rate of exchange, it was not necessary to put by more than the amount already provided. When, however, they were in more fortunate circumstances, then he should say they might resume increasing the reserve; but it would be useless to cripple their final balance by taking £2000 from it, while they added to the reserve on the other side. This would be merely a question of book-keeping, for which there was no necessity at the present time. Then it would be noticed that there were loans on debentures to the amount of £42,020; while last year the amount stood at £45,770. They had managed to pay off some of the debentures as they fell due; and the shareholders would see the Directors had done so with perfect ease—leaving a sufficient balance of cash for their purposes. The amount of the debentures being less, of course the interest under that head was also less, as would be seen by the general revenue account. The capital outlay during the year had been £1755, owing mainly to new pipes laid to take on new business; so really that was a satisfactory item. In this sum, he ought to mention, was also included the expenditure for the completion of the railway siding for the works. They had their coal supply at the present time under fortunate circumstances; and he did not see that those circumstances were liable to disturbance. The coal was received direct into the works by this new siding; and he believed its cost to the Company was less now than it had ever been. The other items in the accounts required very little comment. As regarded the revenue, the report explained that coke had not yielded so well owing to the competition of the "up-country" coke. Then respecting tar, there were large importations from Europe, which obliged the Directors in self-defence to reduce the price at Calcutta; and he thought that measure helpful as regarded its future action—that was to say, that those who sent tar from Europe could not sell it on advantageous terms, owing to the reduction made by the Company—that it would discourage them from repeating the operation. Recently they had had an amalgamation of the suburbs with Calcutta; and this had been a very satisfactory thing for the Company, inasmuch as it had enabled them to obtain 560 more public lamps at a remunerative rate. The increase of consumption among the natives was not very considerable. The Directors were frequently drawing the attention of the Manager (Mr. D. C. Niven) to that; and he was quite sure, from the zeal which he evinced in other matters, that finally they would gain all that was to be gained from the natives, but it was very difficult to get much out of them. They preferred things very cheap, although they might be inferior; so they showed a partiality for cheap oil and cheap coke. Therefore it was not possible for the Company to go on very fast in increasing the consumption of gas and coke. He was very pleased to be able to report that the Directors had renewed the engagement with Mr. Niven for a further five years. Their Manager had shown himself so thoroughly apt at conducting the business entrusted to him, and he did it so worthily and ably, that it was really an advantage to the Company to have his continued services under the circumstances which prevailed at Calcutta, not trouble with the workmen or coal as in this country, but that greater trouble which seemed to faithfully remain by them—the rate of exchange, which was a serious matter for them. He did not know that it was necessary for him to say anything more. He had alluded to the principal topics in the report; and the shareholders would see, to summarize the situation, that they had a good reserve fund, amounting to 10 per cent. of the capital, and they had £12,319 of undivided profit, after payment of the £18,000 required for the dividend. This, he thought, was a very favourable state of affairs, and did not need any lengthened comment; and he hoped the statement would be gratifying to the shareholders. He dared not predict what the future would be; but he might say that at the present time everything was going on satisfactorily, except the exchange. He then moved—"That the report of the Directors and the statement of accounts be received and adopted."

Mr. C. HILL seconded the motion, which was unanimously carried.

On the proposition of the CHAIRMAN, seconded by Mr. J. BLACKET GILL, a dividend of 6 per cent. (free of income-tax) was declared for the past six months, making, with the interim payment, 10 per cent. for the year.

Mr. HILL next moved, and Mr. N. E. B. GAREY seconded, the re-election of the retiring Directors (Messrs. Backler and Hammack).

The motion was unanimously passed.

The Auditors (Messrs. R. Hesketh Jones and A. T. Eastman) were re-appointed, on the motion of Mr. ELLIS, seconded by Mr. A. COOKSON.

The services of the Local Committee, Manager, Secretary, and staff having been duly acknowledged,

Mr. EASTMAN proposed a vote of thanks to the Chairman and Directors; remarking that the present were hard times for companies who had to deal with the unfortunate question of the depreciation of silver, in the way of making profits abroad, and then having to send them home at the heavy loss the low rate of exchange entailed.

Mr. H. D. ELLIS, in seconding the motion, said he was sure that, during the time that had elapsed since the shareholders last met, the attention and anxiety of the Directors had been very much strained in regard to the matter of exchange. If the Chairman would allow him, he should like to say a few words on this question. It meant, in plain language, that £18,000 sent over from the other side melted down to £10,000 by the time it reached the Company. He was one of those individuals who liked to look on the bright side of things, if he could possibly find a bright side; and if they looked upon this question from the point of view of this country, they might discover a feeble ray of light to cheer them. He could remember the time, when he was in India, when the rupee was at a premium, and when £1000 sent over from this country did not produce 10,000 rupees; but now £1000 would produce 18,000 rupees. He thought that this to a certain extent pointed to a favourable channel for English capital to run into. Just as water ran into a channel down hill, so capital would run into the most favourable channel for its application; and if English gold could be sent out to produce a currency premium of 80 per cent. of its value, he thought it must inevitably tend to go out there, and so increase the volume of trade and commercial enterprise. The Company were not sending out further capital just now; and therefore such an operation did not directly affect them. But he thought that a great undertaking like theirs, which was employed in supplying a necessary every-day commodity, must be benefited to a considerable extent by the increase of trade and enterprise produced by the general flowing of capital into the country where they carried on their operations; and to that extent they would gain something by the high rate of exchange. Of course, he was looking at the matter from the point of view of this country; but when they came to send profits back, then they were hit. In the long run, however, this high rate of exchange would attract capital out to India; and, if it did, he thought the Company must benefit by it to a great extent.

The motion was cordially agreed to.

The CHAIRMAN, in replying for himself and his colleagues, said he was very thankful to Mr. Ellis for expressing himself as he had done in regard to the rate of exchange, because he had found some difficulty in arriving at the same result in his own mind; but it was comforting to find there was someone who could come to cheer them up.

This concluded the proceedings.

The Gas and Water Works at Altona.—The Municipality of Altona (near Hamburg) are about to raise a loan of £500,000, for the purpose of purchasing the local gas and water undertakings.

The Electric Lighting Scheme at Burnley.—The Burnley Corporation have accepted tenders amounting to £9316 for electric lighting plant. At the last meeting of the Town Council, it was stated that the original estimate was £19,000, and application had been made to the Local Government Board for power to borrow £23,000. The lighting area is to be 2200 yards; but provision will be made at the supply station for extensions if necessary.

The Proposed Purchase of the Runcorn Water-Works by the Local Authority.—The Runcorn Improvement Commissioners have for some time had under consideration the purchase of the Runcorn, Halton, and Weston Water-Works; and at a meeting last Tuesday, they resolved to give £67,500 for the undertaking. Resolutions to this effect were passed; and it was decided to promote the necessary Bill in the ensuing session. The capital of the Company is £53,400.

BAHIA GAS COMPANY, LIMITED.

The Ordinary Half-Yearly Meeting of this Company was held last Thursday, at No. 9, Queen Street Place, E.C.—Mr. EDWARD HORNER in the chair.

The SECRETARY (Mr. T. Guyatt) read the notice convening the meeting; and the Directors' report and the statement of accounts were taken as read. The former showed that the amount brought forward from the previous half year was £3788; and the balance available for division was £10,077. Out of this, the Directors recommended the usual payments on the preference shares (less income-tax), and a dividend at the rate of 8 per cent. per annum (free of income-tax) on the ordinary shares. This would absorb £6225; leaving £3852 to be carried forward. The report further stated, concerning the termination of the concession, that since the meeting of the shareholders in May last (when an arrangement had been entered into for the continuance of the supply of gas for three months—viz., until Aug. 9), a further arrangement for six months had been made, which would end on Feb. 9 next. Strong representations had been made to the authorities in Bahia by the Manager as to the unfairness to the Company of a prolongation for another short period, especially having regard to their conduct in dealing with the Company; and they had been informed that the Company would not be willing to continue the supply of gas after Feb. 9 for a shorter term than one year.

The CHAIRMAN moved the adoption of the report and accounts; and, referring first to the revenue account, said it would be seen that the receipts for the half year amounted to £21,863. For the corresponding period of last year, they were £19,502; so that there had been an increase of £2360. Eliminating the item of exchange in the two half years, the ordinary expenditure was £298 less; thus showing that great care had been taken in the matter of expenditure, where care could be exercised. The question of exchange was a very serious one, over which, however, the Company had no control. At the meeting of the shareholders twelve months ago, it was thought that £2347 loss on exchange was a very formidable item; but the total for the past half year was £5190. Notwithstanding this very large increase, the result of the half-year's working enabled the Directors to recommend a dividend at the rate of 8 per cent. per annum on the ordinary capital, which he hoped would be considered satisfactory by the shareholders. Alluding to the balance-sheet, he said it would be seen that the amount owing for the public lamps and public establishments had reached the large total of £14,437, or £4037 more than at June, 1891. In addition to this want of consideration for the Company in the matter of gas supplied (payment for which was due on the 5th of the month following delivery), the authorities, particularly the Fiscal Engineer, were treating the Company with very great injustice, by inflicting fines for the public lamps, alleged to be unlighted or with small lights. So irksome had the position become, that their Manager had been compelled to make very strong representations to the Governor against the unfair treatment; at the same time intimating that, unless an alteration was immediately made, and the arrears for the public lighting paid, it would not suit the Company to continue the service after Feb. 9 next, and that arrangements would be made for discontinuing the supply of gas on that date.

Mr. HORATIO BROTHERS seconded the motion.

Mr. MACHELL thought that, with the exception of the loss on exchange, the accounts were satisfactory. The question of exchange was a serious one for many companies. He was a shareholder of the Western Brazilian Telegraph Company; and their dividend had, in consequence of the loss, been reduced 1 per cent.

The motion was unanimously carried.

On the proposition of the CHAIRMAN, seconded by Mr. BROTHERS, the dividends recommended in the Directors' report were declared.

The CHAIRMAN moved the re-election of the retiring Directors (Messrs. Horatio Brothers and H. W. Andrews).

Mr. H. FINLAY, in seconding the motion, remarked that Mr. Horatio Brothers had been associated with the undertaking for something like twenty years. He came into it when it was in very low water; and had done a great deal to work up the property. As to Mr. Andrews, he had been out to Bahia, and was therefore well acquainted with the affairs of the Company there.

The motion having been passed,

The re-appointment of the retiring Auditor (Mr. Magnus Ohren) was unanimously agreed to.

On the motion of Mr. JABEZ CHURCH, seconded by Mr. H. L. ANDREWS, a vote of thanks was passed to the Chairman and Directors; and afterwards the services of the Engineer (Mr. G. Martin), the Secretary, and the staff were suitably acknowledged.

The proceedings then terminated.

AN ELECTRIC LIGHTING FATALITY AT BROMPTON.

A Man Killed by an Electric Shock.

On Monday last week, Mr. L. DREW held an inquiry, at the Kensington Town Hall, into the circumstances attending the death of Thomas P. Lang, aged 22, an assistant-fitter in the service of the House-to-House Electric Lighting Company.

Mr. HURD, solicitor, appeared for the Company; Mr. E. FARMER represented the relatives of the deceased.

The CORONER, in opening the proceedings, remarked that the case was one of peculiar interest to the scientific world; it being a death caused by electricity.

Evidence of identification having been taken,

David Jones, a jointer in the service of the Company, said that Lang was working with him on the previous Wednesday in Roland Gardens, Brompton Road. Lang was in a box; and the witness signalled to him to draw back one cable. Deceased drew it about a foot, and it then stopped. Witness looked out of his box, and saw Lang in a bending position over the wire. He went to his assistance, and discovered that the wire was attached to his hand. When witness saw the position Lang was in, he ran back to his own box, and procured an axe, with which he severed the cable. It was well protected by rubber, and had this been perfect the deceased could not have received the shock. Lang was grasping the cable; and, immediately it was severed, he fell to the ground on his head. The whole thing happened in about half a minute. They were engaged making a connection with a private house; but the wire was in the main road.

The CORONER: In a case of this kind, was it necessary to make a circuit to get a shock?

Witness: Yes.

Then how would the circuit be made?—By the deceased grasping the wire, and placing his other hand on his box.

In answer to Mr. HURD, witness said it was quite likely that, in drawing back the cable, the deceased might have rubbed the india-rubber covering against the edge of the pipe, and thus exposed the copper wire. The whole current would then enter the man's body. The current was turned off at eleven o'clock in the morning, and on at three o'clock in the afternoon. It would take them about an hour to replace the cable; but, having finished the connection, witness considered the job at an end.

Albert Saxby, a plasterer, who was passing Roland Gardens at the time of the occurrence, gave similar evidence.

Mr. *H. W. Bowden*, Engineer and Assistant-Manager to the Company, deposed that he had carefully examined the cable, and had no hesitation in saying that it was one upon which any man could safely work with the current on.

The CORONER: Can you account for the accident?

Witness: I think that, while the man was pulling the cable out, he must have come to a part where the rubber was off the wire. The part of the cable where it touched the man's hand is bare, and the copper wire is exposed. It is dangerous to touch the bare wire.

Are the wires ever examined?—Yes; they are tested whenever an installation is made.

In answer to a juror, witness said he was of opinion that the cause of death was the severing of the covering of the wire. He could not say whether the rubber was removed before the accident, or by the heat of the man's hand. He was confident that there was not sufficient leakage of electricity to earth to have caused death.

What was the strength of the current?—2000 volts.

A letter was handed in from the Company to the deceased, in which he was cautioned against touching the wires without wearing the india-rubber gloves which are provided.

Witness said rats could get into the pipes; and they might have eaten the rubber. He had known of cases of the kind.

Dr. *H. A. Clowes* stated that, on the day in question, the deceased was brought to the Queen's Jubilee Hospital at 4.20. He was dead upon admission, and there was a strong smell of burning, not unlike gas. The palm of the hand and fingers were burned and charred. There was congestion of the face and neck, and suffusion of the eyes; and in other cases of death from an electric shock, the same symptoms had been observed. So far as he could see, there was no burning or singeing about the clothes. His boots were examined, in order to ascertain how he had made the circuit; but nothing could be found. A *post-mortem* examination had since been carried out; and the congestion was still noticeable. No singeing of the hair could be found. There was not a clot of blood in the whole of the body; and this was remarkable.

The CORONER: You have heard that there was a shock of 2000 volts. That would cause instantaneous death?

Witness: The cause of death was shock from the electricity. This makes the sixth case that has occurred in England.

The CORONER, in summing up, pointed out that the deceased had not obeyed his orders by wearing gloves, because the Manager had stated that, if these had been worn, the accident would not have occurred.

Jones (recalled) said he had received a letter from the Company about wearing gloves, but he had not done so.

The CORONER: In spite of the orders?

Witness: We did not think them necessary.

The jury returned a verdict of "Accidental death;" adding, as a rider, that they did not attach any blame to the Company.

The Scarcity of Natural Gas in Ohio.—It is reported that the supply of natural gas in Ohio is falling off to such an extent, that it has to be forced through the mains by pumps. Two or three years ago, nearly every well gave out gas at great pressure.

Water-Works Extensions at Bishop Auckland.—On behalf of the Local Government Board, Colonel Luard held an inquiry at Bishop Auckland, last Thursday week, concerning an application by the Local Authority for sanction to borrow a further sum of £2500 for the completion of the water undertaking. There was no opposition.

Sales of Stock and Shares.—Last Wednesday, 50 shares in the *Kildwick Parish Gas Company* were sold by auction at Bradford at £12 15s. each; and six original shares in the *Clayton and Allerton Gas Company*, at £18 apiece.——At Lynn, a few days ago, £100 of the general stock of the *Lynn Gas Company* realized £172, and £200 produced £328. On the same occasion, two lots of ten £5 shares in the *Hunstanton Gas Company* were disposed of at £51; and five similar lots, at £1 less.——Ten 3½ per cent. £20 bonds of the *Newark Corporation Water Department* have lately changed hands at £204.——At a recent sale by auction, the following prices were realized for stock of the *Tonbridge Gas Company*: £50 "A" stock (10 per cent.), £111; £30 of similar stock, £67 10s.; two £50 parcels of "B" stock (7 per cent.), £77 10s. and £78 10s.; £30 of similar stock £50; £33 15s. of ditto, £55 10s. On the same occasion, ten £10 shares in the *Leatherhead and District Water Company* fetched £10 5s. per share; five others, £10 7s. each; and another parcel of five, £10 6s. each.——At the Mart, Tokenhouse Yard, last Thursday, 350 new ordinary £10 shares in the *Southend Gas Company*, interest at 7 per cent., were disposed of at prices ranging from £14 2s. 6d. to £14 7s. 6d. per share—the greater number fetching £14 5s. each. The total amount realized by the sale was £4986.——Ten £20 "E" shares in the *Godalming Gas Company* were recently sold by auction, and realized the following prices: Two, £33 10s. each; four, £34 each; four, £34 10s. each.

THE METROPOLITAN WATER SUPPLY COMMISSION.

(*Lord* BALFOUR OF BURLEIGH, *Chairman*; *Sir* G. B. BRUCE, *Sir* A. GEIKIE, *Professor* DEWAR, *Dr.* W. OGLE, *Mr.* G. H. HILL, *and Mr.* J. MANSERGH, *Commissioners.*)

Twenty-second Day—Friday, Oct. 21.

Mr. *C. E. De Rance*, C.E., F.R.S., member of the Royal Meteorological and Geographical Societies, and Secretary of the Underground Water Committee of the British Association, was the first witness called to-day. In answer to the CHAIRMAN, he stated that he had paid special attention to the subject of underground water. He had made an examination of the north-western portion of the county of Kent (which included, to a great extent, the district of the Kent Water Company), and also Kent generally, for water purposes for the London, Chatham, and Dover Railway Company. There were four different methods by which the water absorbed in the chalk might be said to reach it—by rain falling on bare chalk; rain falling on patches of impermeable drift clay, off which it flowed by gravitation, and was absorbed in the chalk at the edges (which Professor Boyd-Dawkins had called the "umbrella" method); rain falling on impermeable tertiary outliers; and rain falling on impermeable tertiary outliers, and being directly delivered to the chalk beneath them by natural swallow-holes. No doubt there were many instances of these holes in the district; and there were also those very remarkable artificial openings which were known as the "Dane holes," which were excavated in the face of the tertiaries. These were very numerous along the North Kent area; and they had been investigated by local societies. These holes were supposed to have been made by the Danes, when they inhabited the district, for the storeage of corn and other valuables. A large number had been found; and no doubt a greater number still were not known, because the apertures of these dry wells became covered up in the woods. Sometimes a heading, or large chamber, was driven, terminating within 4 or 5 feet of the chamber in the next shaft, as though the holes belonged to different tribes or families; and there was evidence that they were formed upon some comprehensive plan. In the calculations he had made, he began with the well-known fact than an inch of rain absorbed gave 40,000 gallons per day. He took the drainage area at 110 miles; and he ascertained that the maximum yield had not yet been reached. He found the Kent Company were only pumping about 14,000,000 gallons of water per day; and, so far as he was able to learn, they had never, except under exceptional circumstances, pumped more than 17,000,000 gallons in one day. Calculating out the 17,000,000 gallons per day over their present drainage, on the area he conceived as drained by their wells, it only amounted to 3¾ inches of rain per annum; and taking it at 14,000,000 gallons, it would be considerably less. Consequently, as he believed, from his general experience of porous rocks in various parts of the country, that the district was capable of yielding 10 inches, it seemed to him that they had a very considerable margin to the good. This rested on the assumption that the 10 inches of rain percolated. They could only judge of one district by another. They had the fact that chalk was capable of holding more than 2 gallons of water per cubic foot; whereas the sandstone which was so largely pumped by Nottingham, Liverpool, and other towns, would hold only about 0·75 of a gallon. So that it would appear that the chalk was capable of containing more than twice as much as the sandstone. If this was so, it had an important relation to the quantity of water the chalk could yield; because, in a district with which he was very well acquainted in the neighbourhood of St. Helens, he had occasion to find out the exact yield of water from a triangular tract of new red sandstone which was almost entirely surrounded by impermeable coal measures. By ascertaining the quantity of water pumped by the various public and private authorities, he found that the total yield year by year, without any diminution, amounted exactly to 10 inches of rainfall. If chalk could hold more than sandstone, it seemed to be a very fair assumption to make that it would be able to give out a similar quantity. Looking at the matter in a general way, he thought that the conditions of the percolation experiments were altogether so different from those in Nature, that, except as a useful comparison, they were really of very little value. He had taken into account the number of inches of rain which actually fell on the district in question. There was more than 30 inches on the high, and nearly 30 inches on the low ground; and therefore he considered they were pretty right in taking one-third of the rainfall. It would be safe to give one-third to this particular district; and that would be 3 inches. He had taken four different stations on Mr. Symons's rainfall area—three of them over ten years, and one (a high station, at about 600 feet) for four years; and, averaging these, they worked out to about 27¾ inches. These places were at Westerham, in the south-western corner of the Kent Company's district. They were 811 feet above Ordnance datum; and the average was 30·60 inches of rainfall—Greenwich Observatory averaging for the ten years 23·09 inches. He had also a gauge belonging to the Company's works at Knockholt, 800 feet above Ordnance datum; and the average was about 36 inches. The other assumption he made was that they could get a large portion of this water which percolated. Theoretically, they might suppose that, if any diminution took place, it would be in the higher regions, where seasonal variation was greatest from natural causes, and that, if any artificial abstraction of water took place, it would be there that the pinch would be first found. As far as this particular works was concerned, he believed it would be ascertained, upon investigation, that the supposed depletion was due more to natural causes than anything else. He had on several occasions made inquiries in regard to the Cray during the last ten years, when he was employed in the district. The general conclusion he came to was that, at present, practically no diminution had taken place. The one great cause of the belief that it had done so was due to the sewering of the Cray. The valley of this river had been sewered; and a great deal of the work was carried through very heavily watered strata, and below the water-level. He knew, from his own experience, that, after a sewer had been constructed in watery strata, notwithstanding that it was made water-tight, all the local wells had subsequently run dry, simply because the sewer in the water-bearing strata had formed a plane of weakness along which the land water was travelling outside the sewer. He thought that the present high level of the Deptford wells showed that the volume of water taken was not in excess of that received—that, in other words, they were not at present trading upon capital.

The CHAIRMAN: We know that, to some extent, drawing off from 14,000,000 to 17,000,000 gallons of water does affect the natural sources of the springs. Does not that raise a presumption in your mind that, if much more than this were taken, the influence would be more seriously felt, and that it is therefore improbable that such a supply as 44,000,000 gallons could be obtained?

Witness said no. He intended, by 44,000,000 gallons, to say that this was the quantity he believed would go in, on an average, every year; but, of course, if they sponged and squeezed it, they could not get quite so much out of it. He had stated that the sources of supply would be capable of producing 44,000,000 gallons per day from the chalk; but he also meant that this would be obtained from the impermeable tertiaries. There must be a balance of waste; but he gave no credit whatever for a very considerable tertiary and drift area overlying the chalk. It appeared to him that one balanced the other; and it might therefore be fairly supposed that a very considerable portion of the whole of the water absorbed might be obtained. He had no doubt that some portion of it might be coming out in the bed of the river; and so they could take for human consumption what was at present wasted. At Grays they had so small a gathering-ground that, when a number of people commenced pumping, they pumped all the fresh water that fell upon it; and, this being so, a reversal of circulation took place. This was the reason for those wells being salt. At Liverpool they had a similar thing; and it was gradually becoming worse. Asked why 16 inches of rainfall should be supposed to be absorbed over the area of which he had spoken as ready to be brought into contribution to the water supply of London, as against 10 inches elsewhere, witness explained that the quantity of water which could be held in rock depended upon the interspaces between the grains of the rock. In the chalk these were so small that a microscope was required to see them; while in the case of green sand, the grains were large enough to be visible with the naked eye, and were loosely aggregated so as to give free facility for water to move in all directions, and justify the estimate of 16 inches, or even show it to be too small. It was true that this estimate was an assumption; but it was one based on the facts that compact red sandstone would absorb 10 inches, and that the green sands were much more porous than it—so much more so, in fact, that he assumed they would hold very nearly twice as much as the other.

Examined by Sir A. GEIKIE as to his statement that, in the area served by the Kent Water Company's works, there were 110 square miles of chalk, witness mentioned that he had neglected any quantity of water that might get into this formation through the various drifts upon it; and in this way his estimate of the water to be obtained was, he should consider, under the mark. There would, he thought, be a very large accession to the chalk draining from the various impermeable areas. When he spoke of a daily yield of 44,000,000 gallons being considerably augmented by water flowing off the tertiary area, he thought the word "augmented" was hardly the one to be used, as the augmentation was only in the sense that the water which came from that area replaced water which went from the chalk. To the faults of which he spoke in the Thames Valley, and their bearing on the distribution of water in the Lower Thames, he attached considerable weight. He had paid great attention to faults in various parts of the country; and the universal experience he had was that the fissure of the fault was invariably filled with the material that was originally above it, before denudation took place. With regard to the faults which occurred near Greenwich, he considered them to be a series of fractures in a definite south-west and north-east direction; and took it that all of them tended to raise the flow of water, and throw it out in springs; but he had no information to give with respect to the quantity that came out, as he was afraid no gaugings had been made. With reference to the way in which the water issued, he observed that they saw it in some places well up in the bed of the Thames—coming up, between tide marks, under pressure. He had only noticed this in one place; but he believed it extended along the bed of the Thames for a considerable distance. This was water running to waste; and men who were acquainted with it spoke of its purity. Proceeding to deal with the basin of the Medway, witness pointed out that there were 55 miles of bare chalk there; and he said he should take it as a district eminently suitable for sinking wells in. Just now, a comparatively small supply of water was taken from it. It was exceedingly open, with a great deal of grass land—very similar to the area now embraced by the Kent Company; and the rainfall on it was about the same as that over the other area. He knew the nature of the overlying deposits; and he thought many of the loams were porous, and the "umbrella" arrangement very largely in evidence. He added that while of the bare chalk there was 55 square miles, of the drift-covered chalk there was 25 square miles—making a total area of 80 available square miles; and if the 10 inches of water that went in could not be taken out, this would be compensated by the impermeable areas not accounted for. Speaking on the subject of fissures, witness remarked that he did not believe much in them. He did not say that near the surface they did not form guides and ducts to the chalk water; but he was of opinion that, if it were true that the water derived from rain flowed through the fissures, and was obtained entirely therefrom by pumping, then the chalk water obtained should not have its peculiar character, for it contained a large amount of carbonate of lime. If it passed through the chalk as through a pipe, it would not take up this quantity of the carbonate. Again, they had the chalk waters going in full of organic impurity, and coming out perfectly good—the chalk acting as a filter; but, if the waters flowed simply through the fissures as through drains, they would come out precisely as they went in. Replying to further questions, witness alluded to the large quantity of water that was travelling in a south-easterly direction from the Lea Valley towards the Thames; and he pointed out that there were in the strata a north and a south line of disturbance eastwards of the Lea, and that if the water was not pumped, it would flow into the Thames. There was not, to his knowledge, any evidence

of a large volume of water getting into the Thames on the north side, such as he had shown to be the case on the south side.

Interrogated by Mr. HILL as to the effect on the surface of pumping large quantities of water, witness pointed out that it would depend upon the position of the wells. If they pumped a great deal near the margin of their basin, it was perfectly obvious that they must in a short time make an impression on the streams; but if they put the wells in other well-chosen localities, where the strata were water-logged, there would not, he thought, be any appreciable effect on the volume of the streams.

In reply to Professor DEWAR, witness explained that water never came away from the chalk unless this was saturated. That water had been sometimes called "water of porosity," and sometimes "water of capillarity." But, in any case, they did not obtain any supply from the chalk until it was saturated; and when it did yield water, it was when pressure of water upon it was relieved from below. He had no experiments to show the rate of the percolation through the chalk under normal pressure; but, when saturated, water dribbled away from it the moment pressure was put on.

Sir *J. Evans*, the Vice-President of the Royal Society and Chairman of the Hertfordshire County Council, was then called. He put before the Commission the results which had followed the percolation of a certain number of inches of water through the soil under his own observation. They were obtained from gauges kept at Nash Mills, Hemel Hempstead, for more than 50 years. The average amount of rainfall that percolated through 3 feet of soil overgrown by vegetation he calculated at about 7½ inches. The gauges were covered with grass; and therefore he thought they gave a trustworthy example of what went on in Nature. In places where there was no vegetation, a little more percolation took place. Two gauges, made under precisely similar conditions, would give a slightly varying result; but it was worthy of confidence. He divided the year into summer and winter. There was less percolation in the former than in the latter season, partly on account of the increased vegetation and evaporation. Of late years, they had constructed new gauges; and there were certain discrepancies in them which were somewhat difficult to account for. The figures arrived at in the previous calculations could not, however, be far from the truth. In studying percolation, the one great point was that they must consider the manner in which the rain fell. If they had a succession of heavy rains which saturated the soil, the amount would be found to be very much greater. In the summer months, in some cases, even with a fall of as much as 18 inches, no water passed through some of the gauges. His impression was that the variation between the chalk and the soil arose partly from the capillarity of the chalk. Taking certain sets of three years, the average of percolation was not greater than from 3 to 4 inches. If they were to rely on soil of this kind for a water supply, they must take the minimum. The mean annual rainfall in Hertfordshire he took as somewhere about 26½ inches. In 1888-9 the percolation was good. There was nearly 11½ inches of rain which apparently percolated at that time; and the summer percolation was 3 inches. In the year 1860, with 36½ inches of rain falling, the total amount that seemed to have percolated was only 12½ inches. The years 1877 to 1880 were what he called dry ones.

Asked by Mr. HILL whether, looking at the supply being taken in three consecutive dry years, in the second year of the three no advantage would be gained from water stored (say) from previous wet seasons, witness said he should imagine that it would take two years, or possibly three, before the raising of the plane of saturation during an extremely wet year was entirely done away with; but a great deal depended upon the way in which the rain fell. He had alluded to 16 inches of loss if the rain fell gradually through the summer; but if it came in heavy rainfalls, the water would be all lost.

Mr. HILL: You might have the same quantity, or much less. You might have 10 inches where water came off, if it fell at short periods heavily?

Witness: That is exactly what I wished to point out to the Commission. It is quite a mistake to suppose that you can say any percentage of the rainfall descends to the springs. You find it is stated that a third or a fourth of the rainfall finds its way down; but such a statement is, to my mind, absolutely fallacious and deceptive.

Mr. MANSERGH: You have given us an illustration of the lowering of the plane of saturation owing to diminished percolation in a dry year. Are we to understand your view to be that the result would be just the same if, from the lower part of the valley, you pumped a larger quantity?

Witness: Very much the same.

Sir A. GEIKIE re-directed attention to the question of the influence of the pumping in the valley of the River Lea. He said the witness had stated very positively his opinion that the effect of pumping was to lower the level of the streams; he said that it must be so.

Witness: According to my view of the matter.

Sir A. GEIKIE remarked that one did not doubt for a moment that pumping would lower the level in the cone of depression; but he said he was rather anxious to get from the witness what were the facts that led him to believe that Water Companies' pumping affected the water-level in the upper parts of the stream.

Witness replied that they had the cone of depression near the pumping, and the level was lowered; but this was filled up there, and compensated for again by water higher up the stream.

That may be so; but I fail to see that pumping going on and the quantity taken out would really lower the upper waters?—I do not say myself that you can get any physical proof that it is so; but I think that the theory is absolutely true. The water taken away by pumping must be supplied by water which would otherwise have found its way into the river.

It is, then, a matter of theory?—It is a matter of theory; but I believe that theory so strongly that I regard it almost as a matter of fact.

On being asked to look for a moment on the effects of pumping on the Chadwell Spring—one of the Companies' pumping-stations being not very far therefrom, and pumping a large quantity of water, but producing no visible effect on the yield of the spring—witness mentioned that, as had been pointed out, the spring was apparently in communication with some of the springs in the chalk. He knew of another of those large springs which delivered a considerable quantity of water, but was to some extent dependent on the tertiary formation—that was, on the water which found its way into the swallow holes. Then, if they were pumping in the neighbourhood of these streams, naturally the delivery, coming from a distance, would be affected by the cone of depression which was formed in the immediate neighbourhood. Asked if he did not think, apart altogether from the source from which the water came, if the level was lowered by pumping, it would be felt near the neighbourhood of the pumping first of all, rather than at a distance from it, witness said it depended upon the proportion the pumping bore to the stream that was going by. Subsequently, witness added a statement, to which the Commission promised to give particular attention, that, at some of the sewage works along the valley of the Lea, the sewage found its way into the soil more rapidly when the Water Companies' pumps were not going than it did when they were being worked. In conclusion, he requested permission to make a remark with regard to the right claimed by companies to take the whole of the water within their areas, irrespective of the interests of the neighbourhoods, and of those who were interested in the streams.

The CHAIRMAN: That is a question for Parliament.

Witness: It is a very wide question. I merely wish to enter a protest against it on behalf of the County of Hertford.

Mr. *Colin Docwra*, of the firm of Messrs. T. Docwra and Son, well sinkers and contractors for public works, who have been actively employed for the past 60 years in sinking wells in the London Basin and elsewhere, related experiences which, in his estimation, showed that the standing level of the water in the Upper Lea Valley was in some wells higher than it was from seven to twelve years ago; and he expressed the opinion that other wells might be sunk on sites judiciously selected.

In reply to Mr. HILL, witness remarked that only a very slight effect had been produced on adjoining wells by the sinking of those which his firm had constructed; but in certain cases the works had been known to affect wells some distance—say, about a mile—away. As to fissures in the chalk, in several places they met with many; and they had been found in most of the wells in the Lea Valley. Concerning disappointments in getting water, he could only speak of one well which they had sunk as a failure, or a partial failure, and this was one that they put down for the Cheshunt Local Board; and there, in his opinion, they did not go low enough. The largest quantity they had ever obtained from any of these wells was 4,500,000 gallons in 24 hours' continuous pumping.

Mr. *T. E. Young*, F.I.A., was next called to speak to the comparative mortality from typhoid fever in the area served by the Kent Water Company, and in those supplied by the other seven Companies; and he stated that they could not trace to the Thames or the Lea water, as filtered by the Companies, the diseases which were usually supposed to result from drinking impure water.

The Commission then adjourned till Nov. 15.

Twenty-third Day—Tuesday, Nov. 15.

On the resumption of the inquiry to-day, evidence was given as to the character of the river water supplies from a chemical standpoint.

Dr. *W. Odling*, F.R.S. (Professor of Chemistry at the University of Oxford), was the first witness examined. He mentioned that for a quarter of a century he had been concerned with questions of water supply, and had been associated professionally with Dr. Frankland, and latterly with Mr. Crookes and the late Dr. Meymott Tidy, in connection with the river-derived water supplies of London. He was engaged with Dr. Frankland in the analysis of the water for the last Royal Commission; and with the other gentlemen, under instructions from the Metropolitan Water Companies, in making a further examination of the water. He then submitted some general evidence as to the superiority of the river supplies of London, in respect of their freedom from coloured tint and from excessive hardness and turbidity. He said the colour of the water was habitually good; it being very much less tinted than the filtered Severn water and that of Loch Katrine. With regard to turbidity, it was generally quite bright; but occasionally cases occurred in which the filtration was not so effective. Mr. Crookes had found that only 12 out of 23,000 samples were decidedly turbid. As to hardness, this varied a little. Generally, the supply from the Thames had from 14 to 17 degrees of hardness; and it was somewhat less in summer and autumn than in winter and spring. The hardness of the New River supply was substantially the same as that of the Thames water. That of the East London Water Company was to an insignificant extent harder. That of the Kent was about 20 degrees, or an average of 4 degrees harder. Personally, he should be very content if the river supply was somewhat less hard than it was; but when one had experience not only of the supply in London, but also of much harder supplies in other centres, one could not say that the hardness of the former made it unfit for use. Calling attention next to considerations—medical, chemical, and bacteriological—as evidence of the wholesomeness of the supply, he pointed out that the Registrar-General's tables established the ordinary low death-rate of London, and its steadily decreasing death-rate from zymotic, and especially typhoid diseases; and he observed that the only point was as to the non-influence of outbreaks of typhoid fever or zymotic disease in the up-river districts on the corresponding death-rates of London. They would, for example, find that, in the period 1869-70-71, there was an appreciable typhoid outbreak at a good many up-river towns—at Chertsey, Oxford (which at that time discharged its sewage untreated into the Thames), Reading, Abingdon, and Eton; and also in the Lea basin, at Ware and Hertford. But there was no perceptible increase in the death-rate from typhoid in London.

The CHAIRMAN: Do you put it before us that no degree of danger is imparted to water, as delivered by the Water Companies, by such an outbreak of fever in the upper reaches of the rivers as you have indicated?

Witness replied to this extent—that there was no increase noticeable. He added that there was another similar instance. The occasions of outbreaks of typhoid in the towns on the upper reaches of the river were not very frequent; but there was a distinct one at Chertsey in 1885, and that was accompanied by a steadily diminishing typhoid death-rate in London. As to the extent of this outbreak, the average

number of deaths from typhoid fever in Chertsey from 1868 to 1891 was 5·4, while in 1885 it was 31, in a population at the time of 24,000 or 25,000. It was evident, he affirmed, that no general outbreak of fever or zymotic disease was traceable to the water supply furnished from its present sources; and they had it in evidence that the great bulk of the towns on the Thames—the large towns representing a population of probably 500,000—had ceased to discharge untreated sewage into the river, so that there had been a great removal of the untreated ejecta of the population.

The CHAIRMAN: Are you satisfied with the state of matters now existing as regards the treatment of the sewage from the places above the intakes of the Water Companies?

Witness replied that he had seen a good many of the systems at different times; but, of course, it was a question of continuous watching, which he did not pretend to at all. He only knew well what took place at Oxford; and of this he should speak later on. Coming to the extreme dilution and reduction to an exceedingly minute proportion of the amount of sewage or like matter which still found its way into the rivers, he said he noticed that this brought in the question very much of what had been called the "sentimental objection," which he wished to point out had no substantial foundation. People had an idea that, because a certain quantity of sewage was discharged into a river—whether it was a large or a small proportion did not matter; it was sewage and nastiness, and this was sufficient—the water was polluted by it. He called attention to the extremely minute proportion of any addition of this kind, supposing it to remain in the river unchanged; and this was making a very great supposition, as he would show that it underwent a very rapid change. He would put a case of this kind. If they had 100,000,000 gallons of pure water, and added 100 or 120 gallons of strained sewage, or (say) a gallon of fresh urine—that would be the day's sewage or urine of three or four persons—the idea of taking such water would, at first sight, be exceedingly offensive. But, when calculated out, it would be found to be equivalent to one drop of urine in 12½ gallons. So the actual pollution would be exceedingly small, even on the supposition that it remained urine, which it did not. What he meant to say was that the pollution was much less than was imagined; and when they considered that in the River Thames, from Hampton upwards, there were probably 30,000,000,000, 40,000,000,000, or 50,000,000,000 gallons, one saw that, with the discharge here and there of these relatively minute quantities of sewage, supposing it to remain sewage, the extent of pollution was perfectly insignificant.

The CHAIRMAN: Are you prepared to connect your supposititious case at all with the actual state of matters?

Witness: Well, of course, it is very largely in excess of the present state of matters. Put it in this way: There are (say) a million persons living in the Upper Thames Valley, and, as they knew, a very small proportion of the excreta from them found its way directly into the Thames; but if all the urine went in untreated, then, compared with the case he had suggested, it would be as 1 gallon of fresh urine to 10,000,000 gallons of water.

The CHAIRMAN said he was still doubtful as to whether or not the case corresponded at all with the actual state of affairs.

Witness said he thought it was a fair illustration of it.

Sir A. GEIKIE: The point is whether your supposititious case is anything like or near the facts, or is an over or an under statement. I gather from you that it is rather over.

Witness said it was largely over.

Further questioned by the CHAIRMAN, witness stated that the amount of organic matter in the Thames water was substantially the same as that in Loch Katrine water; and it was often appreciably less. Between July 20 and Aug. 4 of the present year, 16 samples of water were collected daily at a point just above Lechlade; and at the same time samples of the unfiltered water from Hampton were furnished every day. He would give the mean and the maximum results. If they took the organic carbon, the former for the Lechlade water amounted to 0·303 part—that was the mean of the 16 samples—in 100,000; whereas the mean in the Hampton water was 0·154 part. As to the maximum results, for the Lechlade water the figure was 0·353 part; and that for the Hampton water, 0·208 part. The other determinations of the analyses—those with regard to oxygen, organic nitrogen, chlorine, &c.—were in complete accordance with those given; and, further, practically the same results were brought out in monthly analyses made for the County Council of the Lechlade and Hampton waters. Coming next to the question of aëration, he pointed out that it had been found by all chemists that Thames water at Hampton was fully aërated. The weight of oxygen in a gallon of water, at the temperature of 55° Fahr., amounted to 0·6 of a grain; and the weight of ogygen in 100,000,000 gallons would be just under 4 tons. If the temperature was 54° Fahr., it would be almost exactly 4 tons. Accordingly, the weight of oxygen in a mile of river water—say, at Molesey—would be about 2 tons. Now, it was recognized that oxygen had the power of burning up organic matter; and it would destroy about four-fifths of its weight. So the question was whether this oxygen in the Thames water did actually oxidize, or did really destroy, the foul matter introduced. The matter had been examined by a great number of chemists in succession; and they all, with the single exception of Dr. Frankland, had come to the conclusion that there was a very substantial—a very enormous—amount of oxidation effected by the oxygen in the water. Where sewage, or anything like it, was discharged into the river, the oxygen disappeared; and it could only do this by being used up. Then there was the further evidence of an appreciable diminution of organic matter in the water. These were general statements; but he submitted details. While at Kingston the water had its full dose of oxygen—2 cubic inches, or rather more, to the gallon; at Hammersmith, the amount was reduced to nearly one-half; and between there and Somerset House, it was brought down to less than half an inch. Supposing the volume of the river in the latter stretch to be about the same, or only one-tenth greater than that at Molesey, the absorption of oxygen would amount to fully 10 tons; giving a destruction of 8 tons of organic matter in the 9 miles of water. In the stretch of river between Somerset House, and Erith, there was a great absorption of oxygen. Supposing that here the river volume was the same as at Molesey, that absorption would reach 175 tons, with a destruction of some 140 tons of organic matter; while if the volume of water per mile was five or ten times that at Molesey, the destruction would be five or ten times 140 tons. The point he wished to put before the Commission was that, coupling this enormous actual destruction of foul matter with the minuteness of the foul matter added to the water above the Companies' intakes, the allegations of considerable pollution were not well founded. Witness next proceeded to explain that a great deal of sewage and other foul matter that found its way into the river was non-persistent; it did not retain its foul character, but underwent transformation, and became perfectly wholesome. The same phenomenon was observable in regard to vegetable growths in market gardens. The market gardeners manured their land very heavily—using sometimes as much as 80 tons an acre two or three times a year; and this used to be done with night-soil, in days when it was procurable. It followed that when people ate strawberries, cauliflower, lettuce, celery, or other produce of the market garden, they were really partaking of some of the identical material which formerly existed in the form of manure. And so it was in regard to sewage, &c., discharged into the Thames. The transformation it underwent, if not so obvious, was quite as real; it ceased, in fact, to be sewage. Another good illustration was furnished by the growth of the mushroom, in which matter underwent rapid transformation. The presence of organic matter in water was not in itself an evil, provided it was not unwholesome; and that it was not necessarily unwholesome was shown by the circumstance of its existing in fully oxidized water, although they knew that unwholesome organic matter absorbed oxygen absolutely. Coming to flood water, he said this was difficult to filter. They frequently found it more or less opalescent; and sometimes slightly discoloured, by reason of its containing matter in suspension. Of course, the flood water brought down a much greater quantity of impure matter than the ordinary flow. But the water was charged with oxygen, and underwent rapid oxidation; and, if it was stored, this oxidation would continue. The amount of oxygen in the Thames water, as it was delivered in time of flood, was not in any way diminished. Turning next to the subject of microbes, witness said he wished to remark, at the outset, that the question whether or not pathogenic organisms existed in Thames water, and were present to an extent likely to do harm, he considered to be a very serious and grave one; but, as regarded the mere presence of microbes or bacilli generally, the whole thing was preposterous, because it was very well known that there were bacilli everywhere.

The CHAIRMAN: Perhaps you will turn your attention more particularly to the pathogenic organisms.

Witness said that as the subject had not yet been fully investigated, it was necessary for him to speak with a certain amount of caution. First of all, there were the bacilli known respectively as the cholera and typhoid bacilli. Whether or not these particular organisms were the specific causes of the diseases named, had been questioned. The balance of evidence seemed to him to support the theory that they were; but whether they were or were not was a small matter, because if they were not some other organisms were.

The CHAIRMAN: Do you select the cholera and typhoid bacilli as being the only two that communicate disease by water?

Witness: I am not prepared to say there may not be others; but these are the only ones of which we have evidence.

Is anthrax a disease communicable to the human species?—Undoubtedly, but not by swallowing; only by a cut-surface injection or inoculation.

Then for our present purpose we may disregard anthrax entirely?—Yes.

In reply to further questions, witness said the typhoid bacillus had been recognized in certain foul waters, such as those of the Seine, for instance. But it had not been discovered at all, although searched for, in Thames water; nor had the cholera bacillus. This did not prove the absence of these organisms; but it was a proof of their fewness and of their non-multiplication. Pathogenic organisms had, by way of experiment, been introduced into Thames water; and it was found that they did not thrive. They gradually disappeared, and died out by some process of degradation. In conjunction with Dr. Smith, he had made experiments in the culture of cholera and typhoid bacilli, and found that, under favourable conditions, their vitality was maintained for weeks and months. This was in culture broth—a strong animal liquid in which microbes developed rapidly. In opposite conditions, like those prevailing in the Thames, they soon degenerated and died out.

The CHAIRMAN: Would it be wrong to suggest that in that case the spores, or spawn, of the microbes might not be destroyed?

Witness replied that these particular organisms were generally held not to form spores. Where they were produced, as in the case of the anthrax bacilli, they might, no doubt, exist in the water for months, notwithstanding dilution.

The CHAIRMAN: Then we may take it that the typhoid organisms do not form spores?

Witness: They have been searched for, and an opinion has been expressed that they form spores; but the general consensus of the authorities is that they do not.

Replying to further questions, witness pointed out that, whereas river water was fully oxygenated, deep-well water was almost free from oxygen. It had been suggested, in connection with outbreaks of fever which had occurred through the contamination of deep-well water, that organisms might exist in such water which would have no chance of existing in an open river. These particular organisms did not thrive in a medium that was not congenial to them. As to their capability to produce particular diseases, the general opinion was that it required a very considerable dose of the pathogenic bacilli to do it. This was proved by experience in regard to vaccination and inoculation. Experiments had shown that the Thames water, as it left the filter-beds of the Water Companies, did not contain more than from 10 to 20 bacilli of any kind in a cubic centimetre. This being so, the number in a pint would not be very considerable; and even if they escaped the filtration, it was a question whether they would be capable of exciting any of their characteristic diseases. Dr. Smith and he had made experiments in which water purposely charged with cholera and typhoid bacilli had been passed through filters representing as

nearly as might be those of sand used by the Companies. As a result, they found that, when the filtering was done at a very rapid pace, some of the bacilli came through; but when it was done much slower, the removal of the bacilli was so perfect that it was impossible to set up disease by them. There was a large body of evidence pointing to the extreme unlikelihood of the persistence of pathogenic organisms in river water.

The CHAIRMAN: In your opinion, would any analysis that was purely chemical—leaving out the question of the quantity of bacilli—form a safe criterion of the fitness of the water for potable purposes?

Witness: In one sense, yes; because, where the water is free from organic matter, its condition is opposed to the growth of pathogenic organisms, and where its freedom from organic matter persists, it is evident that there is no more pollution of the water than its powers of oxidation are capable of getting rid of.

Do some bacilli, whether harmful or harmless, escape the filtration, even as conducted at the present time?—Yes.

If some which we will assume to be harmless, and of a certain size, escape, might not some others that are harmful escape also? Is there anything about these pathogenic organisms that makes them more likely to be restrained by filtration than the harmless ones?—No.

Then it resolves itself into a question of difference of size?—It does not strike me in that way. I think the more minute these particles are, the more liable they are to be laid hold of. Many of the bacilli met with in common water are larger than the cholera and typhoid bacilli, and some are of the same size.

In times of abnormal flood, if the flood water was impounded and stored, what would be the effect upon its purity of its standing in the reservoir?—Chemically it would be improved.

By Professor DEWAR: The analyses made in July confirm me in the opinion that the water at Lechlade now is worse than at Hampton. I still believe that the best position for taking water from the Thames for the supply of London is at Hampton. A large amount of purification takes place between Lechlade and Hampton, in spite of the additional pollution. There was much greater pollution of the Thames in 1869, when we made our first analyses, than there is at the present time. Whatever the amount of impurity now brought into the Thames between Lechlade and Hampton, it is substantially destroyed or got rid of by natural processes combined with artificial methods of treating the sewage. There is abundant evidence that water gets rid of its organic matter by storeage. If the flood water of the Upper Thames could be stored in reservoirs, and then subsequently subjected to filtration, I am satisfied that the London supply would be in every way as good as it is now. I see little to be desired in the way of improvement in the present method of filtration. I should always favour abundant storeage before filtration, as it would lessen the work the filters have to do.

By Sir A. GEIKIE: Taking all the circumstances into consideration, the idea of Thames water, as delivered by the Companies, producing typhoid fever may be dismissed as imaginary.

Professor DEWAR: Are you aware that, in many large cities, the introduction of a water supply absolutely beyond suspicion of impurity—as in the case of Dublin—has been followed by no sensible diminution of typhoid fever.

Witness: It has been concurrent, somehow, with an increase.

Mr. *W. Crookes*, F.R.S., was next examined. He produced tables from 1881 to the present time, and diagrams for the years from 1881 to 1885, showing the relationship between the results of analyses by the combustion and oxygen processes. He also pointed out that the amount of organic carbon was generally taken as a measure of the organic matter present in a water, but that it did not give any indication as to the animal or vegetable origin of that matter. He submitted tables giving the amounts of organic carbon in London waters. The organic matter had, he said, been slightly diminished as a whole; and London stood very high in the list of towns in this respect. He adopted the views of Dr. Odling as to oxidation; and he put in a supplementary paper to show that there would be practically no danger and no inconvenience in using flood water of the Thames stored in large reservoirs. Impounded and subsequently filtered, this water should, in his opinion, constitute as good a supply as the present. Indeed, if the water was contaminated, it would be improved in the reservoirs, by the increased aëration it would undergo there. As to flood water in the Thames, the results of his analyses showed that it had not the slightest effect on the quality of the supply. The filtration systems of the Companies were amply capable of dealing with the variations.

The CHAIRMAN: Does any chemical analysis form a safe criterion for drinking purposes?

Witness: Chemical analysis all round would give a very safe criterion.

If you found the chemical tests satisfactory, you would have no hesitation in recommending the water?—None.

Professor *W. R. Smith*, F.I.C., Medical Officer of Health and Public Analyst for Woolwich, gave evidence in detail as to the experiments which, in conjunction with Dr. Odling, he had conducted in regard to the existence of micro-organisms in the waters of the Thames and the Lea, as delivered after filtration by the various Water Companies. These experiments tended, he said, to show that the organisms that were found were non-pathogenic. He had not examined the raw or unfiltered water; and therefore could not say whether or not it contained pathogenic organisms which were removed by filtration. There was nothing in the Registrar-General's mortality tables to show that London was specially subject to typhoid fever; the population was exceptionally free from it, rather than otherwise. In none of his experiments had he been able to discover any pathogenic organisms in the filtered water. As it was certain that such organisms must, at some time or other, get into the Thames, the fact thai none were to be found was, to his mind, a proof of their rapid destruction.

The Commission then adjourned till the following day.

Eels in Water-Pipes.—Considerable anxiety has been caused to the citizens of Limerick, owing to several eels having been found in the water-mains serving the city. The creatures get into the pipes from the intake conduit in the Shannon; and a fear is expressed that the supply may become polluted through the fish dying and decomposing. The water-works were recently constructed at a cost of £35,000.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

A pleasant little gathering of about 40 assembled in Macrae's Victoria Hotel in Glasgow on Wednesday at the presentation to Mr. M'Gilchrist, mentioned in another column. It is almost needless to say, however, that nearly all the gentlemen came from the neighbourhood of Glasgow. Mr. Hall, of Montrose, the President, was perhaps the most distant member present; and next to him would be his neighbour, Mr. Carlow, the Secretary, from Arbroath. Mr. Mitchell, of Edinburgh, who has all along taken a great interest in the North British Association, was able to put in an appearance; and so was Mr. A. MacPherson, of Kirkcaldy, who attended as a very old and attached friend of Mr. M'Gilchrist. Mr. Hislop, of Paisley, Mr. M'Gilchrist's colleague in the Vice-Presidency of the Association, contrived to find time to take a run into Glasgow for an hour or two; though, business calling him away, he had to leave before the proceedings were quite over. Mr. A. Wilson, of the Dawsholm works, Glasgow, notwithstanding the anxieties of one of the worst fogs of the season, was also able to devote some time to honouring Mr. M'Gilchrist. I also observed Mr. Carmichael, of Barrhead, Mr. L. Hislop, of Uddingston, and others. The company was also honoured by the presence of Mr. D. W. Stevenson, R.S.A., the sculptor of the bust of Murdoch which was placed in the Wallace Monument last July. Mr. M'Crae, of Dundee, had a meeting of his Commission that day, and was therefore unable to be present; as were also Mr. Stewart, of Greenock, and one or two others, who sent apologies for absence. The portrait of Mr. M'Gilchrist is a "Kitcat" one, and besides being excellent in pose, is an admirable likeness. The presents which were given to Mrs. M'Gilchrist were of most chaste design and beautiful workmanship. That they will be most highly prized, and deservedly so, too, goes without saying. I write from both sides; Mr. M'Gilchrist deserved well of the members of the Association, and the members have risen to the occasion and honoured him in a way which might almost be described as overwhelming. That was Mr. M'Gilchrist's feeling, for it was apparent, when acknowledging the gifts, that he was unable to collect himself so as to find the expression which is usually so ready in his mouth. On the part of the other speakers, there was, however, no apparent lack of expression. The oratory was voluminous, as it always is on such occasions—in fact, everyone was in the best of humour, and the function passed off in the most happy fashion.

The residual products works at Elliot, near Arbroath, which belonged to Mr. John Dobbie, have been purchased by Mr. W. Briggs, asphalte manufacturer, in Dundee and Arbroath, from the trustee on Mr. Dobbie's sequestrated estate. The works were recently exposed for sale by auction at the upset price of £7500, but failed to find a purchaser. Mr. Briggs has secured them privately at a much less figure.

The Renfrew Corporation Gas-Works would appear to require renovation. During the past half year, the output of gas was 3,777,400 cubic feet, of which 906,000 cubic feet, or 23·98 per cent., are unaccounted for. This is too much to lose; and the Corporation ought to see to it that the percentage is reduced.

The Police Commission of Huntly, in Aberdeenshire, have taken up the subject of acquiring the local Gas Company's undertaking. It came up, along with proposals for the better control of the public lighting, but was continued till the next meeting of the Commissioners. It is worthy of note to observe that there was no feeling of hostility to the Company—a thing which is unusual in such situations.

The Dundee Gas Commission, on Wednesday, fixed the charge for the use of meters in connection with their electric lighting installation at 12½ per cent. on the cost. This charge works out as follows: Ten ampere meters (Ferranti), 15s. per annum; twenty ampere meters (Ferranti or Aron), 16s. 3d.; thirty ampere meters (Ferranti or Aron), 18s. 9d.; forty ampere meters (Aron or Kelvin), 21s. 3d.; fifty ampere meters (Kelvin), 24s.; and sixty ampere meters (Kelvin), 28s. per annum. These charges will add considerably to the consumers' accounts. It was reported that applications have been received for current for 870 lamps of 16-candle power, or their equivalent; and that, with the 16 arc lamps it is proposed to erect on the streets, the applications are equal to 25 per cent. of the capacity of the installation. The light is expected to be turned on shortly after the beginning of the new year.

The Aberdeen Corporation are about to apply to Parliament for powers to raise money for the extension of their gas-works and the improvement of the water supply. In the latter is included the subject of preventing the pollution of the River Dee; and the powers asked are for the construction of intercepting sewers at Kincardine, O'Neil, Aboyne, Ballater, and Braemar, the works to be constructed by the Aberdeen Corporation at the cost of the County Council and Local Authorities. Besides this, the construction of a settling reservoir and of a service reservoir is proposed. The outlay contemplated on all the schemes is about £330,000.

It is announced that an electric lighting company is intending to begin the laying down of its plant in Coatbridge at the end of this month. The announcement is not made by an enemy, because it goes on to say that "the necessary machinery is being built at present, and when completed and erected, will be of the highest class, and will embrace all the most modern improvements and ideas in electric lighting. The Coatbridge installation is intended to be a model in all respects; and it is anticipated that the Company will be able to supply electric light as cheap as, if not cheaper than, gas." The undertakers are doubtless honest in all they say they are doing; but it is open to question if they can anticipate that it will be possible to undersell gas at 3s. 9d. per 1000 cubic feet.

Mr. W. C. Martin, electrical engineer, of Dundee, lectured on Wednesday night before the Dundee Technical Institute on the subject of "Electric Light and Power," and made a statement regarding the Dundee installation which requires looking at. Speaking of the cost—which in Dundee is to be 5d. per unit—he said that, for every 1000 watts, they obtained 264-candle power. "To get an equivalent from gas, they would consume 66 cubic feet, which, at its present cost, would be 2½d., or about half the cost of electric light for the same candle power." Mr. Martin there fell into a mistake. Taking the light of 25-candle gas at 5 candles per cubic foot, the light from 66 cubic feet

would be 330 candles, and not 264; and the cost of gas would be 2d., and not 2¼d. But that is a comparison with gas consumed in ordinary burners. If regenerative lamps were used, the light would be trebled—that is to say, nearly 800-candle power would be got from gas for 2d., as against 264-candle power from electricity at a cost of 5d.

The information regarding the filters that are so easily clogged with the impurities in Glasgow water, which I desiderated last week, has now been given, and the name of the manufacturers as well. The filter is not the property of a Glasgow firm, but of A. Haache and Co., who are represented in Glasgow by Mr. A. W. Warner. Mr. Warner writes to a newspaper in Glasgow, that their "H" filter, which is intended to pass 600 gallons per day, gets clogged in Glasgow with one day's work. In Oxford Street, London, the same filter works for three or four days. He is having the deposit on the carbon analyzed. It is his intention, if possible, to adopt the suggestion contained in *Truth*, and to have Loch Katrine water analyzed at the Loch. So far so good; but I am not yet convinced that anything has been proved against Glasgow water.

Referring to the paragraph, in our correspondent's "Notes" last week, dealing with the report made by the deputation of the Edinburgh and Leith Commissioners who visited the South Metropolitan Gas-Works last April to make inquiries on the subject of enriching oil, and to the remarks there quoted as having been made by Mr. George Livesey, we are informed by him that he has neither seen nor made any statement to the Commissioners this year, or at any other time, on the question of oil gas; and, if he had, he should certainly not have said in regard to it that "it was not practically possible so to make gas for distribution over a large area." He says that a visit may have been paid to the works; but, if so, the words quoted are only a statement by the Commissioners of their impression of what was said to them. Such impressions, he adds, are never accurate.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Nov.* 19.

Sulphate of Ammonia.—Compared with last week, the demand has somewhat slackened; hence nothing has been gained in the way of an advance in price, which then seemed most probable. This, however, may be but a temporary lull, as there are already indications of considerable requirements, which are likely to be ample to at least maintain values, although the production is rapidly attaining its maximum. The rates are as last quoted, with the exception of Leith, at which port £10 1s. 3d. has been accepted for a few parcels from second hands. The arrangement for restricted exports of nitrate is being carried out—cable advices just to hand estimating shipments for the month at about 50,000 tons, as against 130,000 tons in the same period last year. The market during the week has been rather dull; and the spot quotation is 9s. per cwt.

LONDON, *Nov.* 19.

Tar Products.—Pitch is moving off freely; and the price is firmly maintained. A better market is reported for creosote and common oils; but large quantities, it seems, are being used as fuel by distillers. Benzols appear to have reached a point below which producers will not sell. Buyers, on the other hand, are strongly attempting to still further depress values. Anthracene is firmer; and very little appears to be offering. There is a good deal of inquiry for carbolic acid for forward delivery; but makers would be foolish to sell forward at the present low prices, having regard to the fact that the accumulated stocks of years have entirely disappeared during therecent cholera scare. Prices are as follows: Tar, 10s. to 11s. nominal. Pitch, 28s. Benzols, 90's, 1s. 6½d.; 50's, 1s. 3½d. Toluol, 1s. 2d. Solvent naphtha, 1s. 1d. Crude benzol naphtha, 30 per cent., 7½d. Creosote, 1¼d. Creosote salts, 20s. Pressed naphthalene, 45s. Carbolic acid, 60's, 1s. 3d.; 70's, 1s. 7d.; crystals, 5½d. Cresol, 10½d. Anthracene, 30 per cent., "A" quality, 10½d.; "B" quality, 8d.

Sulphate of Ammonia.—There is a decidedly better market; and business is much easier to bring about than has been the case for some time. Prices are undoubtedly firmer, with a tendency to improve—to-day's value being £10 2s. 6d. to £10 5s., less 3½ per cent. Gas liquor is quoted at 6s. to 7s. per ton.

COAL TRADE REPORTS.

Northern Coal Trade.—The coal trade has been affected of late by the foggy weather, which has interfered with the movements of colliers. Some of the northern collieries have had idle time from this cause; and in consequence prices have been weaker. Best Northumbrian steam coal has varied from 9s. to 9s. 3d. per ton f.o.b.; though there have been one or two pits, exceptionally well placed, that asked 9s. 6d. per ton. Second-class steam coal is dull, and small steam is little altered—its price being from 3s. 9d. to 4s. per ton. There has been a fair demand for household coal; but the price locally is high, and complaints are freely made about it. Bunker coal is in very abundant supply; and with only a limited demand, prices are weak, at from 6s. 10½d. per ton. For manufacturing coal, the demand is steady; but much lower prices are offered for coal, on contract over next year. In gas coal, there has been a very heavy demand. The production is well maintained, and the demand is fully met; so that there has been a large quantity of coal sent away. The prices do not show much movement. For best Durham gas coal, they vary from about 7s. 6d. to 8s. per ton f.o.b.; but in one or two exceptional instances 8s. 6d. per ton is asked. Some additional local contracts have been placed for next year's supply; and generally it may be said that the prices are from 1s. 3d. to 1s. 6d. per ton below those of the contracts that are now running. In the coke trade, a good demand is reported for coke for the local blast furnaces; and for this the price is about 13s. 3d. per ton delivered at the furnaces. Coke for export commands about 15s. per ton. Gas coke varies much in price. For shipment, the demand is reported good, and the prices are maintained; but for use at the local cement works, it is generally believed that contracts at low prices are being arranged for next year—some assertions being made that for such contracts the price will be below 7s. per ton, which is a very low rate compared with that which has ruled of late.

Scotch Coal Trade.—It is impossible to speak of any advance in either demand or prices for coal in Scotland. The low prices ruling in England continue to draw off customers; and as a consequence, fresh shipping orders can scarcely be got. The home demand is, if anything, slackening. Were it not for a sort of unexpressed truce between masters and men—both sides hanging on to what they have got, and neither being desirous to upset existing arrangements—in the hope of better times returning, the outward appearance of affairs would be worse than it is. The miners are, by working only four or five days a week, doing what they can to keep down stocks; but they still accumulate The men could, of course, produce far more coal than they are doing; and the masters, taking advantage of the temper of the men, are not attempting to force the market, with the result that quotations do not go perceptibly down. Neither side has heart to fight; the truth being recognized that to fight against a falling market is a mistake. There is thus every probability of both parties, knowing that circumstances are against them, allowing events to take their course. If any readjustment of wages should be necessary, it is likely to be a peaceful one. Everything depends upon the iron and the shipbuilding industries. Should they manage to throw off the threatened depression—and there is no appearance of that as yet—there would be no loss to either masters or men; but if not, a decline of both prices and wages is a foregone conclusion. It is something new to hear of the better qualities of cannel accumulating; but that is taking place to such an extent (so many owners of gas-works having contented themselves with second and third rate varieties) that there is a talk of restricting the output of the better sorts. The prices quoted (which, however, are not very reliable, as it is understood that in many instances less is being taken) are: Main, 6s. 9d. to 7s.; ell, 8s. to 8s. 3d.; splint, 7s. 6d. to 7s. 9d.; and steam, 9s. 3d. to 9s. 8d. per ton. The shipments for the week were 166,282 tons—an increase upon the preceding week of 9011 tons, and of 27,073 tons upon the corresponding week of last year. For the year to date, the total shipments have been 6,740,562 tons—an increase upon the total quantity in the same period of last year of 878,442 tons.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 896.)

Issue.	Share	When ex-Dividend	Dividend or Div. & Bonus.	NAME	Paid per Share	Closing Prices	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	14 Oct.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	,,	7½	Do. 7 p. c.	10	10½—11½	..	6 10 5
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 4
100,000	20	27 May	8	Bahia, Limited	20	11—12	..	13 6 8
200,000	5	16 Nov.	7½	Bombay, Limited	5	6—6½	+⅛	5 15 9
40,000	5	,,	7½	Do. New	4	4—4½*	+⅛	6 13 4
380,000	Stck.	12 Aug.	12½	Brentford Consolidated	100	212—217	..	5 10 7
150,000	,,	,,	9½	Do. New	100	163—168	..	5 10 1
220,000	20	15 Sept.	11½	Brighton & Hove Original	20	40—42	..	5 9 6
888,500	Stck.	31 Aug.	5	Bristol.	100	104—108	..	4 12 7
320,000	20	29 Sept	11½	British.	20	41—43	..	5 4 8
50,000	10	31 Aug.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	,,	8½	Do. 7 p. c.	10	14½—15½	..	5 9 8
328,750	10	—	—	Buenos Ayres (New) Limited	10	7½—8½	+½	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	98—101	..	5 18 10
150,000	20	12 Aug.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	14 Oct.	13	Commercial, Old Stock	100	232—237	..	5 9 9
165,000	,,	,,	10	Do. New do.	100	180—185	..	5 8 1
160,762	,,	15 June	4½	Do. 4½ p. c. Deb. do.	100	123—128	..	3 10 4
800,000	Stck.	15 June	10	Continental Union, Limited	100	227—232	..	4 6 2
200,000	,,	,,	7	Do. 7 p. c. Pref	100	190—195	..	5 2 7
75,000	Stck.	15 Sept.	10	Crystal Palace District	100	185—190	..	5 5 3
486,090	10	28 July	10	European, Limited	10	19⅛—20⅛	..	4 17 7
354,060	10	,,	10	Do. Partly paid	7½	14—15	..	5 0 0
5,470,820	Stck.	12 Aug.	12	Gaslight & Coke, A, Ordinary	100	217—222	..	5 8 1
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	95—98	..	4 1 7
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	258—263	..	3 16 1
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	116—121	..	4 2 7
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	166—171	..	4 7 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max	100	162—167	..	4 3 10
463,000	,,	,,	10	Do. I, 10 p. c. Prf.	100	255—260	..	3 16 11
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	150—154	..	3 17 11
1,061,150	,,	15 June	4	Do. 4 p. c. Deb. Stk.	100	118—121	..	3 6 1
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	123—127	..	3 10 10
908,000	,,	,,	6	Do. 6 p. c. do	100	165—170	..	3 10 6
3,800,000	Stck.	16 Nov.	12	Imperial Continental	100	220—225*	..	5 6 8
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	4—4½	..	6 13 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5p. c. Deb.	100	106—108	..	4 12 7
541,920	20	16 Nov.	5	Monte Video, Limited.	20	14—15*	+1	6 13 4
150,000	5	27 May	10	Oriental, Limited	5	8⅛—8¼	..	5 14 3
60,000	5	29 Sept.	7	Ottoman, Limited	5	4—5	..	7 0 0
166,870	10	—	2	Pará Limited.	10	2—3	..	—
420,000	100	2 Nov.	6	People's Gas of Chicago— 1st Mtg. Bds..	100	103—107	..	5 12 1
500,000	100	1 June	6	2nd Do.	100	104—106	..	5 13 2
150,000	10	—	10	San Paulo, Limited	10	8¾—9½	..	—
500,000	Stck.	31 Aug.	15½	South Metropolitan, A Stock	100	287—292	..	5 6 2
1,350,000	,,	,,	12	Do. B do.	100	232—237	..	5 1 3
230,000	,,	,,	13	Do. C do.	100	241—246	..	5 5 8
725,000	,,	14 July	5	Do. 5 p. c. Deb. Stk.	100	140—144	..	3 9 6
60,000	Stck.	31 Aug	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
743,952	Stck.	1 July	10	Chelsea, Ordinary	100	247—252	+1	3 19 5
1,720,252	Stck.	14 Oct	8	East London, Ordinary	100	199—204	+1½	3 18 10
544,440	,,	1 July	4½	Do. 4½ p. c. Deb. Stk.	100	140—144	..	5 4 6
700,000	50	1 July	8½	Grand Junction	50	104—109	+1	3 17 11
708,000	Stck.	12 Aug.	11	Kent	100	273—278	+3	3 19 1
1,043,800	100	1 July	9½	Lambeth, 10 p. c. max.	100	217—222	+1	4 5 7
406,200	100	,,	7½	Do. 7½ p. c. max.	100	190—194	..	3 17 3
285 000	Stck.	29 Sept.	4	Do. 4 p. c. Deb. Stk.	100	123—126	+1	3 3 6
510.000	100	12 Aug.	12½	New River, New Shares	100	325—330	..	3 13 6
1,000,000	Stck.	28 July	4	Do. 4 p. c. Deb. Stk	100	130—133	..	3 0 2
902,300	Stck.	15 June	6½	S'thwk & V'xhall, 10p. c. max.	100	147—151	+1½	4 6 1
126,500	100	,,	6½	Do. D 7½ p. c. do.	100	135—140	..	4 12 10
1,155,066	Stck.	15 June	10	West Middlesex.	100	241—246	..	4 1 3

*Ex Div.

The Charge for Water for Manufacturing Purposes at Stockton and Middlesbrough.—The Stockton and Middlesbrough Water Board discussed in committee, on Monday of last week, the proposed application to Parliament for powers to increase the charge for water used for manufacturing purposes, which is at present 3d. per 1000 gallons. The general opinion of the members was that the initiative in this direction should be taken by the Corporations of Stockton, Middlesbrough, and Thornaby.

Complaints about the Electric Lighting at Larne.—At a recent meeting of the Larne Town Commissioners, Mr. Beatty attended, in the capacity of a ratepayer, to complain of the electric lighting. He said that Main Street and other parts of the town were in darkness; and he suggested that a fine of £5 per lamp should be imposed on the contractors every night that the light was out. The present state of things was most unfair to the ratepayers. Mr. Ross considered that Messrs. Gordon and Co., should enter into an arrangement with the Gas Company to supply light on the occasion of the interruptions complained of. The Chairman expressed the opinion that the fine should have been settled when they entered into the contract. The Clerk (Mr. Baxter) suggested that, in case the Gas Company and the electric lighting contractors could not agree, oil-lamps should be kept ready trimmed to hang on the poles. The Chairman thought the suggestion of the Clerk was a good one. Mr. Ross said he was greatly in favour of the electric light at first; but now he was getting ashamed of it. There were some 20 lamps extinguished that night; leaving the important parts of the town in darkness. After further conversation, it was arranged to hold a special meeting of the Commissioners to consider what action should be taken.

Provincial Gas Undertakings as Investments.—In their "Stock Exchange and City Notes" last Friday, the *Echo* referred to provincial gas companies as affording good openings for investment, as the public can tender for small quantities of the stock. Our contemporary remarked that "town after town can be cited where the gas company has paid a steadily increasing rate of interest to its shareholders during a series of years, when almost all other securities have shown a disposition to fall away in value. No excuses of bad times or of the Baring failure are necessary. Company after company in different parts of the kingdom tell much the same tale, and that a highly satisfactory one. The more they lower the price of gas, the higher dividend they are allowed to pay, provided it can be fairly earned; so that both shareholders and consumers are mutually benefited by such an arrangement. Where gas and water are combined, it need hardly be said that additional security is offered." The case of the Hastings and St. Leonard's Gas Company was cited to show the fairness of the system of raising additional capital by tender. A first issue of 3000 £20 shares was made in 1865, and subsequent ones as follows: In 1883, 667 shares; in 1884, 375 shares; in 1887, 375 shares, sold at an aggregate premium of £4752; in 1888, 500 shares, at a premium of £6700; and in 1891, 250 shares, realizing a premium of £4300. For 1886 and 1887 the rate of dividend paid was 8 per cent., allowable by a reduction in the price of gas below the standard of 4s.; for 1888, 8½ per cent. was paid; and for 1889, 1890, and 1891, 9 per cent.

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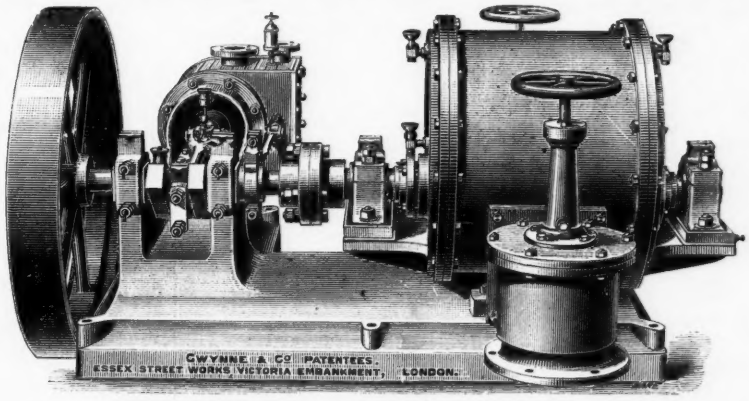

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O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
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TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.
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JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

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Apply by letter, stating capabilities, past experience, age, and terms, to A.X., care of Messrs. Waterlow and Sons, Limited, LONDON WALL, E.C.

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WANTED, an experienced Plumber as
a WASTE-WATER INSPECTOR. One who has been accustomed to Deacon's Waste-Water System will be preferred. Wages 35s. per week.
Candidates to make application in their own handwriting, to the Secretary, at the Company's Offices, Commercial Road, Portsmouth, on or before Wednesday, the 30th of November inst., stating their age, qualifications, and where last employed, and enclosing testimonials.
By order,
R. W. FORD,
Secretary.
Offices: Commercial Road,
Portsmouth, Nov. 17, 1892.

WANTED, Offers of Muriate of Ammonia
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Any further information to be had of the undersigned on application.
E. G. SMITHARD,
Engineer.
Gas-Works, Chelmsford,
Nov. 11, 1892.

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SHOTLEY BRIDGE AND CONSETT DISTRICT GAS COMPANY.

THE Directors of the above Company are
prepared to receive TENDERS for the surplus TAR produced at their Works for the year 1893.
Quantity about 50,000 Gallons.
Contractor must furnish Barrels, and accept delivery at Consett and Blackhill Station.
Tenders to be sent to the undersigned not later than Dec. 1.
M. RICHLEY,
Secretary.

SULPHURIC ACID.

THE Directors of the Sunderland Gas
Company are prepared to receive TENDERS for about 500 tons of SULPHURIC ACID for the manufacture of Sulphate of Ammonia, to be delivered free in Tank-Trucks at their Works, Hendon and Ayres Quay, Sunderland, during 1893. Both Stations are connected with the North-Eastern Railway.
Tenders, endorsed "Tender for Acid," to be delivered at the Company's Offices, Fawcett Street, Sunderland, before Ten o'clock on Wednesday Morning, Nov. 30.
J. H. COX,
Secretary and Manager.

TENDERS FOR SULPHURIC ACID.

THE Directors of the Bath Gaslight and
Coke Company are prepared to receive TENDERS for the supply and delivery, at their Works, by Midland Railway, or by Barge on the River Avon, of about 400 tons of SULPHURIC ACID, in the year from the 1st of January next.
Particulars, with Form of Tender, may be had upon application to Mr. C. S. Ellery, the Company's Engineer.
Tenders, endorsed "Tender for Acid," to be sent on or before the 5th of December next to the undersigned.
The Directors do not bind themselves to accept the lowest or any tender.
By order,
GEORGE HELPS,
Secretary.
Gas-Works, Bath,
Nov. 14, 1892.

CORPORATION OF LEICESTER.

RETORTS AND FIRE-BRICKS.

THE Gas Committee of the above Cor-
poration are prepared to receive TENDERS for the supply and delivery of RETORTS and FIRE-BRICKS.
Specification, Quantities, and Form of Tender, can be obtained from the Engineer.
Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Retorts, &c.," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, Dec. 10, 1892.
The Committee do not bind themselves to accept the lowest or any tender.
ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.
Gas Offices, Millstone Lane,
Leicester, Nov. 18, 1892.

TYNEMOUTH GAS COMPANY.

CANNEL COAL.

THE Directors of the above Company
invite TENDERS for the supply of 200 tons of first-class CANNEL COAL (about 35 candles), and 800 tons of second-class CANNEL COAL (about 20 candles), during a period of Twelve months, to be delivered to the Company's Siding, North Shields, in lots of 20 tons and 50 tons respectively as required.
Tenders, with analysis of Cannel, to be sent to the undersigned, marked "Tender for Cannel," on or before the 29th inst.
The Directors do not agree to accept the lowest or any tender.
By order,
W. B. DAVIDSON,
Secretary.
North Shields, Nov. 19, 1892.

SHEFFIELD UNITED GASLIGHT COMPANY.
NEEPSEND AND ARUNDEL STREET STATIONS.

TO GASHOLDER MAKERS.

THE Directors of this Company invite
TENDERS for the repair and re-sheeting of the Two OUTER LIFTS of a GASHOLDER at each of the above Stations. The Gasholder at Neepsend is 151 ft. diameter by 30 ft. deep, and at Arundel Street 110 ft. diameter by 24 ft. deep.
Forms of Tender, with Bill of Quantities, may be obtained, and the Specification seen, on application to the Engineer, Mr. Fletcher W. Stevenson, at the Company's Offices, Commercial Street.
The Directors do not bind themselves to accept the lowest or any tender.
Sealed tenders, marked "Tender for Repairing Gasholders," and addressed to the undersigned, must be delivered at the Company's Offices by post, not later than Saturday, the 3rd day of December next.
HANBURY THOMAS,
General Manager.
Commercial Street, Sheffield,
Nov. 12, 1892.

LIQUOR and Tar wanted.
BROTHERTON AND Co., Ammonia and Tar Distillers, LEEDS and WAKEFIELD.

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Lux's Gas Regulators for every consumption.
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Lux's Gas-Balance.
Lux's new Gas Regulator for Inverted Lamps and other Apparatus for Gas Lighting, &c.

THE NEWLY-PATENTED BOWER REGENERATIVE GAS-LAMP.

VERY many thousands of Lamps under
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Particulars of GEORGE BOWER, St. Neots, HUNTS.

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THE Merthyr Tydfil Gas Company are
prepared to consider OFFERS for the purchase of about 12 tons more or less of SULPHATE OF AMMONIA
The highest or any offer not necessarily accepted.
Offers must be received not later than the 6th prox., and must be endorsed "Sulphate," and addressed to E. B. Evans, Esq., J.P., Chairman of the Committee of Directors.
Samples and particulars will be supplied on application.
JOHN L. COCKER,
Manager and Secretary.
Gas Offices: Gas-Works, Merthyr Tydfil,
Glamorganshire, Nov. 18, 1892.

EAST LONDON WATER-WORKS COMPANY.

ISSUE OF NEW CAPITAL.

NOTICE is hereby given, that the Di-
rectors are prepared to receive TENDERS for £25,000, being the fifth portion of the New Perpetual Debenture Stock of the Company, to bear Interest at 4½ per cent. per annum, free of Income-Tax, such tenders to be delivered at the Company's Offices, St. Helen's Place, in the City of London, not later than Twelve o'clock Noon, on the 13th day of December, 1892, and payment of accepted tenders made on the 23rd of December.
Particulars and Conditions, together with Form of Tender, may be obtained at the said Offices, or will be forwarded on application.
By order of the Court of Directors,
ISAAC ADOLPHUS CROOKENDEN,
Secretary.
St. Helen's Place, London,
Nov. 5, 1892.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes
the issuing BY AUCTION of GAS and WATER SHARES under Parliamentary Powers.
He also holds MONTHLY SALES of GAS and WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.
The next Sale will take place at the Mart, on Tuesday, Nov. 29, at Two o'clock precisely, by order of the Executors of the late Mrs. E. Randall and Others, of £4500 of 4 per cent. PERPETUAL DEBENTURE STOCK and £450 of ORDINARY "B" STOCK (paying 8½ per cent. Dividend) in the Tottenham and Edmonton Gaslight and Coke Company.
Terms for including Shares in these Sales, and all particulars relating thereto, may be had of Mr. ALFRED RICHARDS.
Offices: 18, FINSBURY CIRCUS, E.C., and TOTTENHAM.

SOUTH METROPOLITAN GAS COMPANY.
£25,000 Five per Cent. Perpetual Debenture Stock of the above Company, presenting an Investment of the soundest description.

MESSRS. G. A. WILKINSON and SON
are instructed by the Directors to SELL by AUCTION, at the Mart, on Friday, Dec. 9, at Two o'clock precisely, in numerous lots, to suit large and small purchasers, £25,000 of FIVE PER CENT. PERPETUAL DEBENTURE STOCK of the South Metropolitan Gas Company.
The districts supplied by the Company comprise nearly the whole of the South of London, from Wandsworth to Plumstead Marshes; and the demand has so much increased that the supply of Gas has been nearly doubled within the last Ten Years.
Particulars may be had of FRANK BUSH, Esq., Secretary of the Company, 709A, OLD KENT ROAD; of Messrs. BUDD, JOHNSONS, AND JACKS, Solicitors, 24, AUSTIN FRIARS; and of Messrs. G. A. WILKINSON AND SON, Surveyors and Auctioneers, 7, Poultry, CITY.

BRISTOL WATER-WORKS COMPANY.

ORDINARY STOCK.

ALEXANDER, DANIEL, SELFE, AND
CO. will SELL by AUCTION, at the Bank Auction Mart, Corn Street, Bristol, on Thursday, the 1st day of December, 1892, at Two o'clock in the Afternoon,
£20,000 BRISTOL WATER-WORKS SEVEN PER CENT. MAXIMUM ORDINARY STOCK,
in convenient Lots of £100 Stock and upwards.
The above £20,000 of Stock is part of 7 per Cent Maximum Ordinary Stock, amounting to £240,000 created under the powers of the Bristol Water-Works Act, 1888.
The Dividend on this Stock is subject to proportionate diminution whenever the Maximum Dividend to which each class of Ordinary Shares or Ordinary Stock of the Company is entitled shall not be paid in full; but such diminution may be made up in subsequent years.
For further Particulars and Conditions of Sale, apply to the AUCTIONEERS, Bank Chambers, Corn Street, BRISTOL (and 34, Old Jewry, LONDON, E.C.); to Messrs. FUSSELL AND Co. Solicitors, 36, Corn Street, BRISTOL; or to Mr. ALFRED J. ALEXANDER, General Manager, Bristol Water-Works Office, Small Street, BRISTOL.

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TAR, LIQUOR, AND SPENT OXIDE
Purchased for Cash against Delivery.

BOLDON GAS COALS.
Worked by THE HARTON COAL CO., LTD.,
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

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For prices, &c., apply to the
HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
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NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

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FOR GAS AND WATER.
Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.
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FOR GAS, WATER, AND STEAM.
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Gas Companies are solicited to try Samples of the
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Prices and Analysis on application.
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Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

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Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip combined.
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Will be found the most efficient appliance of the kind yet introduced.
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Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

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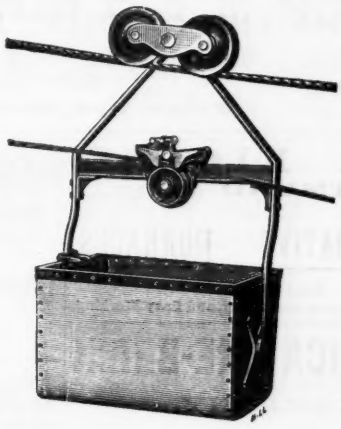

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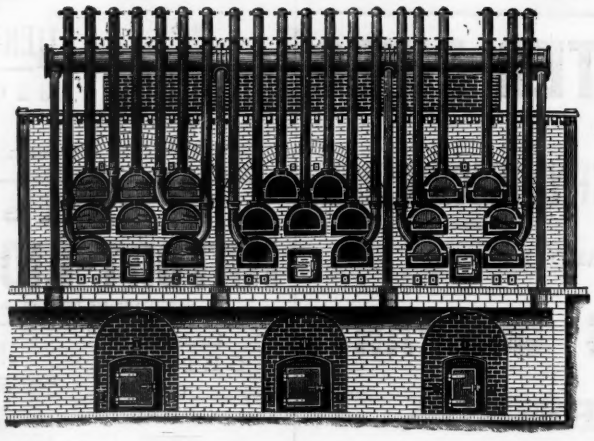

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Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

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Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

ESTABLISHED MORE THAN A QUARTER OF A CENTURY

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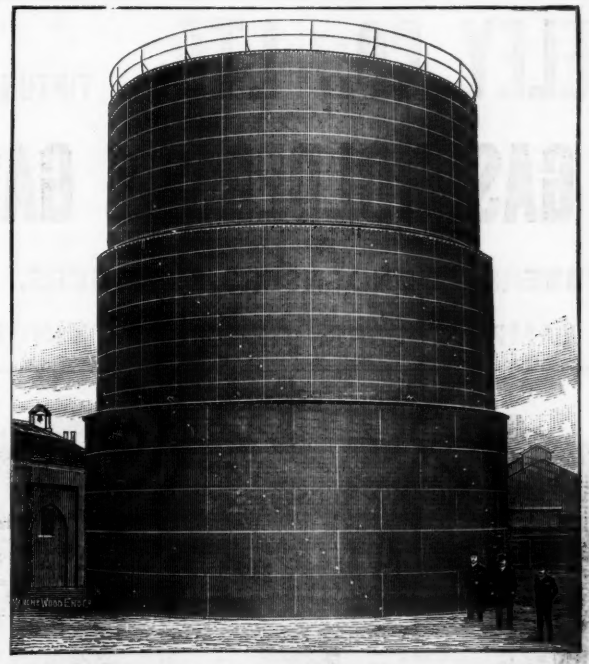
TOTAL WEIGHT REDUCED
from 30 per cent. to 50 per cent.

TRANSPORT AND ERECTION REDUCED
to the same extent; and in cases where gasholders are shipped abroad to places difficult of access, this represents a very large amount of money.

TANK CONSTRUCTION SIMPLIFIED.
The Tank wall (of whatever construction) is a regular cylinder. There are no piers needed, and all expensive foundation stones for the base of columns or standards are dispensed with.



Two-Lift Gasholder recently erected, in a wrought-iron Tank, for the Birmingham Oxygen Company, at their Works, Saltley, Birmingham. The bottom of the Tank is fixed level with the ground, upon a concrete foundation.

COST OF PAINTING SAVED
for the Columns and Girders.

TILTING UTTERLY IMPOSSIBLE;
And as there are fewer parts, there is less liability for the Gasholder to get out of order in working.

STABILITY UNDER WIND PRESSURE
of a Gasholder constructed upon this system is at least equal to, and from experiments and calculations made is far in excess of, that of a Holder of the same dimensions guided by the elaborate guide framing at present in use.

The removal of heavy guide carriages and rollers from the top curbs considerably lowers the centre of gravity of the structure, and dispenses with the extra strength of sheeting necessary to carry these at the points where they are attached to the gasholder.

The plan adapts itself to telescoping to any reasonable extent, and enables very shallow holders or lifts to be employed with perfect stability.

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ESTABLISHED 1825.

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MANUFACTURERS OF EVERY DESCRIPTION OF

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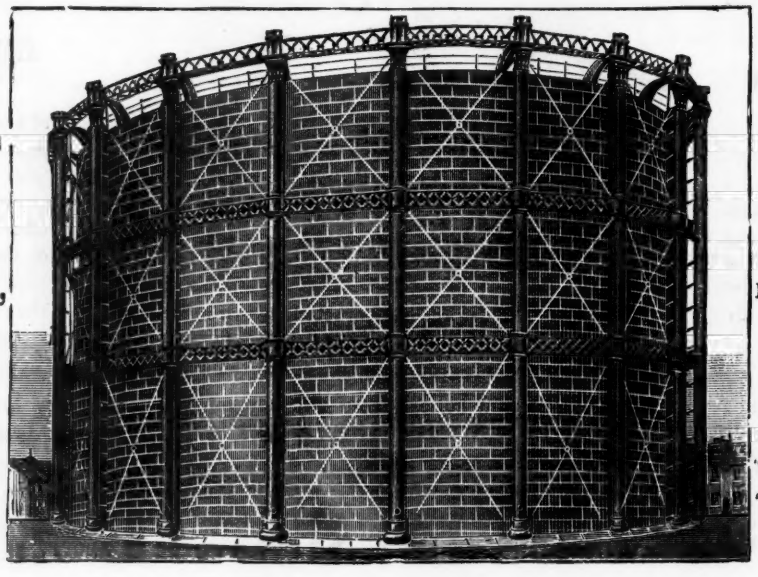

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FOR

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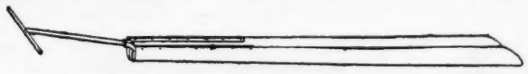

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1. Smooth interior, preventing adhesion of Carbon.
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The Carburettors have been doing practical work for the past two years; in many cases doing all the enrichment without the use of Cannel or other rich Coals. The South Metropolitan Gas Company have these Enrichers at all their Stations. The Gaslight and Coke Company have had them in use at some of their principal Works for two years past; and several more are now being fixed at their other Stations. The Carburettors are also in use at several Suburban and Provincial Gas Companies' Works.

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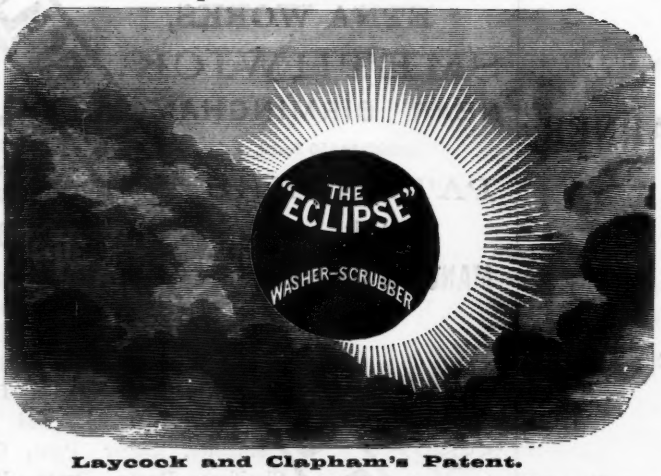

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The Patent Wooden Balls thoroughly break up the Gas; give an immense amount of freshly-wetted Surface; and do not clog or increase back pressure.

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